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June 21, 1999

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Reference: Remedial Investigation Workplan for the HCI-Chemtech site in St. Louis, Missouri

Dear Ms. Warren and Mr. Burnett

Enclosed please find two copies of the Remedial Investigation Workplan for the HCI-Chemtech site located in St. Louis, Missouri. With few exceptions, your comments have been incorporated into the Workplan. The exceptions are discussed below.

Comments 6 and 9

No total metals are available for these TCLP samples. For the CJE report, the concern with the slag buried at depths to the bedrock (up to 42 feet below grade) was only the leachable metals. While I cannot speak for ESE, I assume that their conclusion was the same: if metals are not leaching out at levels of concern, the total metals are not a concern.

Comment 7

The disparity in the laboratory reports was so large that trip or field blanks could not account for the difference. Trip and field blanks typically detect contamination at the parts per billion or very low parts per million level. The extreme variation in the concentrations of the chemicals found, and in the list of chemicals detected in the samples collected in and before December 1995 compared to the more consistent analyses after that time suggests that problems may have occurred in the laboratory. These inconsistencies prior to 1996 may have been due to

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the quality of instruments available at that time, training or experience of personnel, or, as has been suggested for one of the laboratories used, economic pressures which led to rushing samples through the laboratory. While all of these considerations are speculation, the magnitude of the differences in the analytes and concentrations reported suggests that the possibility of laboratory error must be considered to properly evaluate and select laboratories in the future. Because the exact nature of any laboratory error is unproven and speculative, elaboration is not appropriate in the Workplan. It should be further understood that the possibility of laboratory error is not introduced to suggest that the contamination is not present in high concentrations (it most certainly is in some areas), but to suggest that the reader give appropriate weight to the validity of the results. Our selection process for the laboratories for the RI has been designed to select laboratories which can remove any questions as to the validity of the results.

Comment 12

At the meeting to discuss the work necessary at each site, sampling by each tank valve was agreed upon as sufficient. This was based on the fact that, with the exception of Tank 7, no release was observed under any of the tanks at the time the old tank farm was closed. MDNR and EPA agreed that investigation in the area of the valves would be appropriate. If contamination is found in the soil samples from three feet, provisions have been made to continue sampling at depth. The actions suggested by MDNR would require that 18 boreholes be drilled to depths of up to 42 feet with sampling at five-foot intervals with no apparent justification. The field screening methodology has been modified to accommodate MDNR concerns over pH, and all samples from three feet will be analyzed using appropriate methods regardless of the field screening results. The analyses of groundwater samples will also provide information on any additional samples which may be needed to address soil contamination. As always, if the results of field observations or laboratory analyses indicate that additional investigation is needed, HCI will undertake those investigations.

Comment 13

The OVM designated for use at this site, a Thermo Environmental Instruments, Inc. Model 580B, is very effective at detecting aromatic compounds. While this effectiveness does not extend to polynuclear aromatic compounds, the chemicals blended in Tanks 66 and 67 were limited to aromatic compounds. Therefore, the OVM should be effective for field screening in the area of Tanks 66 and 67. The field screening and analytical schedules for the other tanks discussed in this section have been modified as recommended.

Comment 19

The results of the analyses of the groundwater samples collected to date do not suggest

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that the contamination has migrated to the south (see Tables 4-9 and 4-10 and Figures 4-1 through 4-8). This hypothesis will be tested by the results of the analyses of groundwater samples from new monitoring wells MW10 and MW13, which test the chemical composition of ground water to the south, the direction of expressed concern. If the results of the analyses of groundwater samples from these wells demonstrate that additional sampling to the south is necessary, a workplan for additional investigation will be submitted to MDNR and EPA.

Comment 20

We are properly taken to task for this omission. Aquifer tests will be conducted as described in (the new) Section 6.3.

Comment 22

Because it is highly unlikely that vapors harmful to human health or the environment will be emitted from the soil or ground water at the site, it was agreed with MDNR and EPA that one sampling episode would be sufficient. Certainly the emissions from the tanks will produce much higher concentrations of vapors than that which would be emitted from the soil or from the ground water through the soil. Neither the State nor Federal governments require capturing or monitoring the emissions from the tanks at the site. While it is incumbent on MDNR and EPA to require testing to ensure that no harmful vapors are being emitted from the site, it is also apparent that if harmful emissions are present from soil and groundwater contamination, the emissions must be so concentrated that only one sampling episode is necessary to determine if harmful levels are present. Again, if the results are ambiguous, or if vapor levels of concern are found, HCI will conduct any follow on sampling which is necessary. Absent evidence of harmful vapors however, it is not reasonable to conduct periodic sampling at the site.

Comment 27

The vertical scale was given in the title block below the horizontal scale. For clarification, the vertical exaggeration has been added to the legend.

If you have any questions concerning the contents of this workplan, please call me. I will provide any additional information you may require.

Sincerely yours,


Clarence Johnson

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Mr. Bryant K. Burnett
June 21, 1999
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cc: J. Simko
A. Goldmann
M. Sellens
C. Cox
L. Feagan

**DRAFT
REMEDIAL INVESTIGATION
AND REMOVAL ACTION WORKPLAN**

VOLUME I

**FOR
HCI CHEMTECH DISTRIBUTION
139 East Soper Street
St. Louis, Missouri 63111**

Prepared for:

**HCI-Chemtech Distribution Inc.,
424 S. Woods Mill Road, Suite 325
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Prepared by:

**C. Johnson Environmental
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June 1999

PROFESSIONAL CERTIFICATION

The Remedial Investigation and Interim Removal Action Workplan, the Quality Assurance Project Plan, the Sampling and Analysis Plan, the Standard Operating Procedures, and the Health and Safety Plan prepared for the HCI-Chemtech Distribution, Inc. site in St. Louis, Missouri were prepared under the direct supervision of Clarence Johnson, a Registered Geologist in the State of Missouri.



Clarence Johnson
R.G. 1006



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1.0 INTRODUCTION

1.1 Purpose of the Workplan

HCI - Chemtech Distribution, Inc. (Chemtech), a wholly-owned subsidiary of HCI U.S.A. Distribution Companies, Inc. (HCI), operates four chemical distribution sites in Missouri. Two sites are located in Kansas City, the other two sites are in St. Louis and Springfield. To resolve a charge of illegally releasing sodium hydroxide into the Missouri River at one of the Kansas City sites, Chemtech signed a Plea Agreement in April 1997. As part of the requirements of that Plea Agreement, Chemtech agreed to adopt Corporate and Compliance Monitoring Programs (Monitoring Programs). The structure and scope of the Monitoring Programs are defined in a Compliance Agreement, which was prepared by the United States Attorney's Office, the United States Environmental Protection Agency (EPA), and the Missouri Department of Natural Resources (MDNR). The Compliance Agreement was finalized on November 6, 1997.

Part A of the Compliance Agreement requires that a complete summary of all the data available on the environmental conditions be prepared for all of the Chemtech sites in Missouri. The purpose of the summaries is to provide the EPA and MDNR with the available environmental data for the sites which will enable these agencies to determine if there are concerns at the sites which require additional environmental investigation. The summary report for the St. Louis site was completed and submitted to the EPA and MDNR for review in January 1998.

Following the review of the summary report by the EPA and MDNR, a meeting was held in August 1998 to develop a plan for further work at the St. Louis site. At that time, it was

agreed that a Remedial Investigation (RI) would be undertaken to evaluate the contamination at the site.

1.2 Goals of the Remedial Investigation

The RI is being performed to complete the site characterization which was started under earlier programs. The goals of the RI are to:

1. define the margins of significant contamination;
2. define the concentrations of chemicals in the soil and ground water;
3. define all source areas;
4. characterize the stratigraphy;
5. evaluate if contamination from upgradient sources is migrating on to the subject property;
6. obtain the information necessary to complete a risk assessment for the site which will determine the threat posed to human health and the environment by the contamination;
7. determine if a Feasibility Study (FS) and Remedial Action Plan (RAP) are necessary; and
8. obtain the data needed to prepare a FS and RAP, if deemed necessary.

1.3 Organization of the RI Workplan

The workplan has two volumes. The first volume consists of the workplan which describes the work to be undertaken to meet the goals listed in Section 1.2. Volume II is the Quality Assurance Project Plan (QAPP) which provides the protocols which will be followed to ensure that quality control and quality assurance objectives are met. In addition, a compilation

of the Standard Operating Procedures (SOP) which will be used in the field to ensure that the data will be collected in a manner which will not compromise the objectives of the QAPP has been prepared. The workplan in Volume 1 will refer to sections of the QAPP and SOP where appropriate to identify the procedures which will be followed while carrying out the workplan tasks.

2.0 SITE BACKGROUND

2.1 Site Description

The Chemtech St. Louis site is located at 139 East Soper Street, St. Louis, Missouri 63111 (see Figure 2-1). HCI - Chemtech purchased the site from Chemtech Industries, Inc. (CII) in 1992. At that time, the site covered 6.2 acres and included 83 above ground storage tanks, with a total capacity of approximately 7,900,000 gallons. Other structures at the site include a 4,700 square foot office, a 32,900 square foot warehouse, and a 5,700 square foot maintenance shop. In 1995, Chemtech acquired the adjacent property to the south of the Chemtech facility from St. Louis Steel Castings, Inc. (Steel Castings). The area of the acquired site was 8.69 acres. All of the buildings on the Steel Castings site were removed from the site prior to the purchase by Chemtech. Since the time of the purchase of the Steel Castings site, two new tank farms, with improved secondary containment, have been constructed and several tanks have been relocated to these tank farms from some of the original tank farms. A site plan for the current Chemtech site is shown in Figure 2-2.

The warehouse includes space for storage of drums, a maintenance area, a solvent drum filling area, an acid drum filling room, an acid and caustic drum rinsing room, a "white room" for handling pharmaceutical and food grade chemicals, and an 8,500 gallon blend tank in the solvent drum filling room. Matlack Trucking leases the maintenance shop office on the east side of the property. A small laboratory building is located across Broadway Avenue approximately 500 feet west of the facility.

2.2 Environmental Setting

The Chemtech site is located in an industrial area adjacent to the Mississippi River. Broadway Avenue, which runs parallel to the river approximately 200 feet north of the facility, separates the industrial area from residential areas to the northwest. A Coast Guard station is immediately adjacent to the site to the northeast. A metal recycler, Southern Metal, is to the northwest of the facility. To the east and southeast is the Mississippi River and the facility barge dock. To the southwest is Lone Star Cement Company, a cement mixing and distribution facility, and Rhone-Poulenc Agricultural Company, an agricultural chemical mixing and storage facility. The closest residences are approximately 1,000 feet to the northwest of the facility. There are no schools, hospitals, or sensitive environments reported to be near the site.

The site is underlain by a heterogeneous fill, sand and silt layers which appear to be fill composed of natural sediments mixed with slag, a silty clay, and limestone bedrock. The soil stratigraphy underlying the facility is shown in the cross sections in Figure 2-3, with the line of section shown in Figure 2-2. The correlations are tentative because the boreholes have been logged in separate events by at least three persons, and only three of the boreholes were drilled using continuous coring technique.

The fill consists of sandy silt to silty sand with some gravel rich layers. A distinct sediment described as slag is found in amounts varying from zero to 50 percent of the fill. Two thin layers (less than six inches thick) composed completely of slag have been defined. The amount of slag appears to increase to the north, toward the Coast Guard property and to the east towards the river, particularly on the Coast Guard property. The source of the slag is unknown. A reasonable speculation is that the slag may have been imported as fill from the operations at

the St. Louis Steel Castings facility which is adjacent to the Chemtech facility to the south. As discussed in Section 4.4, the slag passed the Toxic Characteristic Leaching Procedures (TCLP) test.

The sand and silt layers have apparently been distinguished in the drill logs by the lack of slag in the sediment and relative amounts of silt and sand. These units have less continuity than the layer described as fill. Neither this unit nor the associated fill have distinct layers described in the drill logs; however it is probable that some indistinct layering exists based on the variability of the fill described in the logs.

The silty clay is composed of river sediments. The features which distinguish this unit from the overlying units are: (1) the black to dark gray color; (2) the amount of organic material; (3) the soft texture; (4) the presence of distinct layers; and (5) the sharp decrease in organic vapor meter readings of headspace samples to zero in this layer.

The limestone bedrock consists of one to two feet of weathered limestone overlying a competent bedrock. This unit is hard and could not be penetrated by the augers or the drive samplers.

During typical Mississippi River flow conditions, the site is approximately 25 to 30 feet above the level of the river. Groundwater elevation is controlled by the river elevation. At normal river stage, ground water is found approximately 20 feet below the ground surface. Groundwater flow is normally towards the river (see Figure 2-4). During periods when the river is rising, a temporary reversal of the direction of flow near the river may occur. There are no known beneficial uses of the ground water near the site, and there are no water supply wells which could be impacted by any releases of chemicals.

3.0 FACILITY OPERATIONS

3.1 Site Operations

The Chemtech St. Louis branch receives bulk liquid chemicals in barges, rail cars, and trucks. These chemicals are transferred to bulk storage tanks (see Table 3-1). Dry chemicals and packaged liquid chemicals are received by truck. From the bulk storage tanks, chemicals are delivered to customers in bulk or are transferred to 55-gallon drums for shipment to customers. Each tank is individually plumbed to the truck loading areas and the solvent filling areas to minimize the need for line flushing. Chemicals may also be blended prior to delivery in bulk or prior to being transferred to drums. Blending operations are conducted in Tanks 61 and 65 in Tank Farm 5, in 4,000 and 1,000 gallon tanks in the warehouse, and in a 1,100 gallon tank in the white room. All chemical transfer operations take place in areas with spill containment including concrete catch basins. Drip pans are used to catch minor amounts of solvents during hose disconnection. All hoses are blown with compressed air to help ensure that no chemicals are left in the hose which could spill when the hose is disconnected from the pump. All drums are sent off site for reclaiming or recycling, except acid and caustic drums which are rinsed at the site.

The total throughput of chemicals for 1997 was 13,500,000 gallons of liquid chemicals and 600,000 pounds of dry chemicals. The throughput for 1998 is estimated to be approximately the same. Of this total, 12,000,000 gallons of the liquid chemicals are received and stored in bulk, and 1,500,000 gallons are received in containers with capacities of 55 gallons or less. All of the dry chemicals are received in packages; no dry chemicals are handled in bulk. Caustics account for approximately 1,650,000 gallons of the liquid chemicals. Acids account for 650,000

gallons of the liquid chemicals. The remaining liquid chemicals are organic products including aromatic solvents, ketones, alcohols, surfactants, heat transfer fluids, aliphatic solvents, glycols, and acetates. Caustics, toluene, and xylenes arrive primarily by barge. All other chemicals are received both by tank car and truck.

Although Chemtech operated its own truck fleet in the past, the trucking operations are currently contracted to Matlack Trucking Inc. (Matlack). At this time, Chemtech owns only two yard tractors for shuttling trailers on Chemtech property. Matlack is responsible for the maintenance of the vehicles, and storage and disposal of any wastes generated by the maintenance of the vehicles.

3.2 Chemical Management

At the time Chemtech was acquired by HCI, the site had 83 above ground storage tanks. The number of tanks reached a high of 92 in 1988. Currently, there are 76 tanks at the site with a total capacity of 7,728,629 gallons. At the time of the acquisition in 1992, the tanks were located in containment areas with concrete walls and dirt floors.

Incompatible chemicals were separated by the walls between the tank farms. The dirt floors would not have been completely effective in containing releases in the tank farms.

Although the property was leased and not owned for two years after the purchase, the tank farms used for storage of alcohols, aliphatic solvents, and some of the aromatic solvents were paved with concrete to improve the secondary containment shortly after the company was purchased. After title to the property transferred to HCI and the purchase of the Steel Castings site was completed in 1996, a new tank farm was constructed with concrete walls and floors for tanks receiving chemicals from barges. At this time only the floors of Tank Farms 1, 2, 4, 6,

and 13 are unpaved. Tank Farms 4, 6, and 13 are used for storage of caustics. There are seven tanks in these farms with a total capacity of 2,340,000 gallons. Tank Farms 1 and 2 have 23 tanks with a total capacity of 207,129 gallons. Only nine of these tanks, with a total capacity of 77,245 gallons, are currently in use. Glycol, alcohol, acetate, surfactant, and acid are stored in these tanks. The tanks in Tank Farms 1 and 2 are progressively being removed from service.

Inventory control is achieved through surveying of barges prior to and after unloading, weighing trucks in and out, weighing drums as they are being filled, and gauging rail cars and storage tanks. Tank inventory is reconciled either weekly, biweekly, or monthly. The schedule is dependent on the environmental hazard posed by the chemical. The inventories of the tanks containing the chemicals with the greatest environmental hazard are reconciled weekly. All tanks are visually inspected every day. There are no underground storage tanks or underground pipelines at the facility.

4.0 PREVIOUS STUDIES

4.1 Introduction

The focus of this section is only the data generated by site investigations. A complete listing of documents with environmental information about the site is in the Bibliography of the summary report, "Environmental Conditions at the HCI-Chemtech St. Louis Site," dated January 6, 1998.

4.2 Pilko Phase I Report

Pilko and Associates, Inc. (Pilko) prepared a Phase I report titled "Environmental Risk Assessment of Chemtech Industries, Inc., St. Louis Distribution Branch" for CII. The report is dated August 1988. This report includes a description of the facility, a description of the operations, the waste management practices, water management practices, a search for evidence of waste disposal onsite, evaluation of spill containment and contingency planning, an evaluation of air emissions, and evaluation of the potential for the presence of polychlorinated biphenyls (PCBs) and asbestos.

There were no soil or groundwater samples collected for chemical analysis as part of this study. However, the report references a study conducted by Geotechnology, Inc. (Geotechnology) in 1984. This apparently refers to a letter included in the appendix to the Pilko report from Geotechnology to Chemtech dated July 18, 1985 and an internal Chemtech memo dated June 19, 1985. The results of the chemical analyses of soil samples are provided in Table 4-1, however, it is impossible to determine precisely the locations and depths at which the soil samples were taken because no site map is available. According to the memo, the highest contamination occurred near the dock, the truck loading bay, the solvent tank farm, and the rail unloading

station. The chemicals which were found and the range of concentrations were: acetone, 170 to 300 parts per billion (ppb); methyl ethyl ketone (MEK), 13,000 ppb; toluene, 2,500 to 1,100,000 ppb; xylenes, 18 to 640,000 ppb; methylene chloride, 46 to 21,000 ppb; and TOX, less than 10 to 190 ppb (although the acronym "TOX" usually refers to Total Organic Halogens, no definition is given in this report and the meaning of this acronym is somewhat speculative). Soil pH ranged from 4.5 to 11.2. The conclusions given in the Pilko report were:

1. No hazardous waste disposal is known to have occurred on site.
2. No significant issues regarding asbestos, safety, security, or fire protection were identified.
3. The location of the site and the local terrain suggest that ground water would flow primarily toward the Mississippi River where contaminants would be diluted and impacts minimized.
4. The disposal of waste at the site appears to be in compliance with applicable regulations.
5. No significant problems have been identified with the discharge of wastewater at the site.
6. The housekeeping appeared to be excellent at the time of the site visit.

4.3 ESE Limited Phase I Audit

Environmental Science and Engineering, Inc. (ESE) prepared a report titled: "Limited Phase I Environmental Audit, Chemtech Industries, Inc., St. Louis Missouri Distribution Branch." The report is dated September 1991. The purpose of the report was to update the environmental assessment prepared by Pilko in 1988. The ESE report includes a description of the facility and

the operations at the site, a description of the waste streams and environmental permits, an environmental violations record search, a summary of spills and releases, and conclusions and recommendations. No soil or groundwater sampling was conducted as part of the assessment.

The results and conclusions were:

1. All required permits were in place and Chemtech was in compliance with the requirements of the permits.
2. The search of the Environmental Risk Information Center records and the State of Missouri data bases found no reasons to suspect an on-going environmental concern at the subject facility.
3. The only spill noted in this Pilko report as having occurred at the facility since a potassium hydroxide spill in 1984, was a release of 44,000 pounds of stannous fluoroborate. Records indicate that the proper notifications were made and that the spill recovery efforts were acceptable to the regulatory agencies.
4. The facility appeared to be in good operating condition. Chemical storage areas were clean and well organized.
5. Audits by the Chemtech corporate office and the MDNR discovered violations; however, the violations were minor and have been corrected.
6. Surface contamination was identified by Geotechnology in 1985. Although this concern has not been further investigated, secondary containment has been improved in the chemical transfer areas where the contamination appears to be centered.
7. The roof on the old section of the warehouse building may contain asbestos.

8. The acid and caustic drum rinse water may occasionally overflow the effluent piping system and discharge to the facility tank farm area.

4.4 CJE Environmental Assessment

In May 1992, C. Johnson Environmental (CJE) conducted a Phase I and Phase II pre-acquisition site assessment of the St. Louis CII facility. The report includes a review of the environmental data available at that time, a description of the physical setting of the plant, a description of the operations at the plant, a description of the chemical and waste management, and a description of the drilling of three boreholes to sample the soil and ground water at the site. The location of the borehole (B1) and the two temporary monitoring wells (MW1 and MW2) are shown in Figure 2-2.

For the investigation of the soil and groundwater contamination, one monitoring well (MW2) was installed near the truck loading area downgradient from the solvent tank farm (Tank Farm 5). Some solvents, notably xylene, toluene, and mineral spirits which are delivered by barge, are also stored in the tanks located close to the barge dock. The second monitoring well (MW1) was installed near the hazardous waste storage area and the barge tanks. The third borehole was drilled near the edge of the river. The locations of the wells and the boring are shown in Figure 2-2.

One soil sample was collected from each of the three borings in the most contaminated zone as determined by headspace analysis of split spoon samples. A groundwater sample was collected from each of the monitoring wells. The samples were analyzed for volatile organic compounds (VOCs) using EPA Methods 8010 and 8020. The results of the analyses are given in Table 4-2.

The analyses of the soil and ground water show that the site is contaminated with aromatic and chlorinated solvents. Higher concentrations of solvents are present in the soils near the tank farms and the truck loading area, than in the soils by the river. The aromatic solvents present at the highest concentrations in the soil samples are toluene and xylenes at maximum concentrations of 200,000 ppb and 56,000 ppb, respectively. Trichloroethene and 1,2-dichlorobenzene are the chlorinated solvents found in the highest concentrations in soil samples at 6,500 ppb and 3,600 ppb, respectively.

The groundwater samples from MW2, which is near the solvent tank farm, had the highest concentrations of all solvents, except for benzene and chlorobenzene which were higher in MW1. MW1 is downgradient of MW2. Toluene (33,000 ppb) and xylenes (20,000 ppb) are the aromatic compounds present in the highest concentrations, and 1,2-dichlorobenzene (2,400 ppb) and trichloroethene (2,100 ppb) are the highest chlorinated solvents.

To evaluate the potential for the casting slag used as fill at the site to impact the environment, two samples were submitted for analysis using the TCLP. No metals were detected in the leachate from the sample collected from MW1. Only mercury at a concentration of 1.6 ppb was found in the soil. This is below the hazardous waste standard of 200 ppb. No total metal analyses were conducted on these samples. However, the total metal concentrations in the slag are discussed in Section 4.6.

The conclusions presented in the report are:

1. The levels of contamination in the soil were all below the MDNR Recommended Safe Levels in 1992.

2. The levels of contamination in the ground water were above the MDNR Recommended Safe Levels in 1992.
3. The casting slag posed no environmental threat.
4. The contamination in the soil and ground water appeared to result from continuing small releases during hose disconnections, leaks in pump packing, and careless handling of hose flushing liquids.
5. If the release of chemicals is stopped, the contamination will diminish through natural attenuation.
6. The contamination at the site does not represent a significant threat to human health or the environment.

4.5 EDP Environmental Assessment at the USCG Facility

The USCG has a facility immediately to the north of Chemtech. In 1992, the USGS commissioned an environmental assessment of their facility. EDP Consultants, Inc., produced an interim report to document the results of their Phase I survey, and a final report which contained the results of their Phase I and Phase II surveys. The Phase I report described the facility, the environmental and geographical setting, the operations conducted at the facility, and recommended that a Phase II assessment be conducted.

The Phase II assessment included the drilling of 17 boreholes to collect soil samples and installing monitoring wells in nine of the boreholes (see Figure 2-2). Samples were collected for analysis for VOCs, semivolatile organic compounds (SVOC), metals, total recoverable petroleum hydrocarbons, and pH. The results of the groundwater analyses are given in Table 4-3.

The conclusions in the report were that there was no threat of environmental impairment as a result of the presence of any chemicals in the soil. The report also concluded that there was no threat of environmental impairment from the presence of metals or SVOCs in the ground water. No conclusion was expressed concerning the results of the analyses for total recoverable petroleum hydrocarbons. The report concluded that the VOCs exceeded the action levels established by the MDNR. Acetone, 2-butanone, cis-1,2-dichloroethene, ethylbenzene, toluene, vinyl chloride, and xylenes were all found in the ground water in concentrations greater than 1,000 ppb. The report also concluded that the source of these compounds is the Chemtech facility to the south of the USCG facility.

4.6 CJE Site Investigation

As a result of the investigation at the USCG site, MDNR requested that Chemtech undertake a site investigation to further define the contamination. The results of that investigation are given in the site investigation report by CJE dated June 30, 1994. The site investigation included drilling three boreholes, collecting soil samples from the boreholes, installing monitoring wells (MW3, MW4, and MW5) in the boreholes, and collecting groundwater samples from the three new monitoring wells and the two existing wells on site. The samples were analyzed for VOCs using EPA Method 624/8260, alcohols by EPA Method 8015 (modified), RCRA metals by acid extraction and atomic absorption, and base/neutral extractable SVOC by EPA Method 8270.

The results of the chemical analyses of the soil are given in Table 4-4. The results show that the VOCs are present in the soil in concentrations less than 1.0 parts per million (ppm) with the exceptions of toluene (1.4 ppm) and xylenes (2.0 ppm). SVOCs were all less than 0.64 ppm

with the exceptions of 2-methylnaphthalene (1.5 ppm) and bis(2-ethylhexyl)phthalate (2.3 ppm). Of the RCRA metals, arsenic (71 ppm) and lead (160 ppm) were present in elevated concentrations. No alcohols were present in the soil.

The results of the groundwater analyses are given in Table 4-5. Of the 33 positive results for SVOCs in ground water, 28 were present in concentrations less than 74 ppb, and five were between 74 ppb and 690 ppb. Of the VOCs, benzene was found in the highest concentration (240,000 ppb). Toluene (20,000 ppb), xylenes (9,500 ppb), cis-1,2-dichloroethene (90,000 ppb), and 1,1-dichloroethane (6,900 ppb) were also present in high concentrations. Barium (870 ppb), arsenic (280 ppb), and mercury (0.5 ppb) were reported in the ground water. Lead was not detected in the ground water. No alcohols were present in the ground water. The conclusions of the report are:

1. The presence of the metals is due to their occurrence in the fill or natural sediments and not to site operations. The concentrations in the ground water and the results of the previous TCLP tests indicate that metals are not a concern at the site.
2. The base/neutral compounds are not a threat to human health or the environment.
3. Based on the results of the chemical analyses, the source of the subsurface contamination appears to be small releases during hose disconnecting and flushing operations over a long period of time. However, the marked increase in the concentrations of benzene and dichloroethenes (DCE) cannot be explained by small releases, because neither of these chemicals were ever handled at the facility as a pure product. It is possible that small amounts of benzene and DCE could

be present in trace amounts in other solvents, but that would not produce the concentrations found in MW2 and MW3. Some of the DCE may be a decomposition product of tetrachloroethene and trichloroethene, but the current and historical levels of these chemicals indicate that only a small amount of the DCE could be present as a decomposition product. The source of the benzene and DCE, as well as other chemicals, could be offsite releases. Further investigation may be necessary to fully evaluate this possibility. An additional explanation for the anomalous concentrations of benzene and DCE is laboratory error. Given the large number of chemicals present and the high concentrations of the chemicals, assignment of chromatograph peaks to chemicals is not always a straightforward task.

4. The sources of the contamination have not been completely defined. For example, acetone has been reported in six monitoring wells on the Coast Guard property. In 1992, the maximum concentration of acetone reported was 20,500 ppb in MW-9. Acetone was reported in only one well on the Chemtech property, MW5, at a concentration of 11,000 ppb. All of the wells between Chemtech well MW5 and the Coast Guard well MW-9 had no detectable acetone in groundwater samples. The wells without detectable acetone include the well nearest the acetone storage tank (well MW2) and the wells downgradient from the acetone tank (wells MW1, MW3, and MW4). Further, in 1992, Coast Guard wells MW-5, MW-6, and MW-7, along the river, had concentrations of acetone that were 1,900 ppb, 2,080 ppb, and 3,100 ppb, respectively, with the concentrations increasing away from the

Chemtech property. The pattern of increasing contamination from MW-5 to MW-7 is repeated in the analyses for benzene, 1,1-dichloroethane, and cis- and trans-DCE.

5. Several steps have been taken to eliminate potential sources of contamination. The most significant was paving the tank farms in which alcohols, aliphatic compounds, and most of the aromatic chemicals are stored. This action should prevent a continuing release of chemicals to the subsurface and permit the existing contamination to naturally attenuate. Monitoring over a period of years may be necessary to verify that natural attenuation is occurring.

4.7 Continued Site Monitoring

Since the completion of the site assessment in 1994, groundwater samples have been collected periodically from the five groundwater monitoring wells on the Chemtech site. The results of these analyses are given in Tables 4-6 through 4-10. Concentration contours for total light phase chemicals and acetone and shown in Figures 4-1, 4-2, 4-3, and 4-4 for 1992, 1994, 1996, and 1998, respectively. Concentration contours for total dense phase chemicals are shown in Figures 4-5, 4-6, 4-7, and 4-8 for 1992, 1994, 1996, and 1998, respectively.

The center of the contamination is MW1 for the light phase chemicals and MW2 for the dense phase chemicals. While the concentrations are apparently increasing in MW1 and MW2, the concentrations are stable or slightly decreasing at the margins. The results for the dense phase chemicals showed a marked decrease in 1996, but the levels have increased to the historical values since that time.

4.8 Release of Caustic Soda from Tank 28

In 1996, a leak was discovered in the bottom of Tank 28. The recovery and cleanup action was supervised by MDNR. It was determined that 23,000 gallons of caustic soda had been released to the soil under the tank. The pH of the caustic soda is 14. The MDNR agreed to the proposal to repair the tank and put the tank back into service. The MDNR also required that a remediation plan be submitted.

To determine the need for remediation, two scenarios were developed to estimate the effect of the caustic soda on the Mississippi River. The two scenarios were based on the probable range of hydraulic conductivities in the aquifer. The conductivities were estimated to lie between 2.8 and 28 feet per day. The calculations determined that the concentration of caustic soda in the river in a mixing zone extending five feet into the river through the ground water would be between 0.26 parts per million (ppm) and 2.6 ppm at the soil/river water interface. At these concentrations, the effect of the caustic soda on the pH of the river could not be measured by practical means. Further, when mixed with all of the water which passes the site on an average flow day, the concentration would drop to between 0.00001 ppm and 0.0001 ppm. At the higher conductivity, all of the sodium hydroxide will pass into the river in 150 days. Lower rates of groundwater transport will lengthen the time, but diminish the impact on the river. Therefore, natural attenuation was proposed as the remediation method. The MDNR has not required any additional action since that time.

4.9 VOC Samples Under Tank 7

During the course of moving Tank 7 to a new tank farm, signs of a release were noted in the soil under the tank. Samples were collected at depths of 1.0 feet, 3.5 feet, and 5.0 feet for

analysis for toluene and xylenes, the products stored in Tank 7. The results of the analyses were: toluene and xylenes at 27 ppm and 273 ppm, respectively, at 1.0 feet; toluene, less than 1.0 ppm, and xylenes, 59 ppm at 3.5 feet; and both toluene and xylenes at less than 1.0 ppm at 5.0 feet. Based on the results of the analyses of soil samples, no further action was deemed to be necessary.

4.10 Phase I and Phase II Audits of the St. Louis Steel Casting Site

In February 1991, ESE prepared a Phase I and limited Phase II environmental audit of the Steel Casting site. The report included a description of the facility, the operations at the site, and a limited facility history. Field work included an asbestos survey, a PCB survey, and analyses of soil samples for waste oil, priority pollutants, TCLP metals, and radiation.

The ESE report states that the facility manufactured high and low alloy carbon steel and stainless steel castings from 1934 to 1986. The steel was melted in electric arc or electric induction furnaces and poured into molds. Potential sources of contamination include the metals brought onto the property, asbestos, oils, paints, radioactive material from testing instruments, and PCBs from the transformers on site. The conclusions given in the report are:

1. The only asbestos present on the site was in the floor tile and mastic in the office and in asbestos cooling trays.
2. TCLP analyses of casting sand and furnace pit samples showed the leachate to be below regulatory levels. No analyses of the total metal content of the samples was provided in the report.
3. PCBs were found to be present above regulatory levels.

4. Low levels of pesticides were found in shallow surface samples. The concentrations were not deemed to be of concern.
5. Total recoverable petroleum hydrocarbons were found to be present above MDNR action levels for UST sites.

4.11 Steel Casting Remediation

Prior to sale of the Steel Casting site to Chemtech, the owner was required to remove all structures from the site and conduct remediation to the satisfaction of MDNR. Environmental Operations, Inc. (EO) was retained by the owner to conduct a site investigation to define all areas for which remediation might be required. Six areas were found which required remediation: the main transformer area (PCBs), the arc furnace area, the TH3/4 area (SVOCs and pesticides), the scrap metal storage area (metals and total petroleum hydrocarbons), the capacitor spill area (PCBs), and the river transformer area (PCBs). A revised remediation plan was submitted to MDNR on April 11, 1995. The report was reviewed and approved by Mr. Timothy Chibnall of MDNR.

The remediation consisted of excavating contaminated soils and collecting confirmation clearance samples to demonstrate that all of the contaminated material had been removed. Excavation began in May 1995 and was completed in June 1995. A report was submitted to MDNR which contained a description of the work performed and the results of the analyses of clearance samples. MDNR approved the remediation in June 1995.

4.12 River Seep Sampling

On November 4, 1998, a sample of the seep from the riverbank on the Coast Guard property was collected for analysis. The results of the analysis are given in Table 4-11. The analyses show that chemicals are seeping into the river from the Coast Guard property.

Daily observations are made from the barge dock for seeps from the Chemtech property. The observations are recorded in a log book kept at the site. No seeps have been observed emanating from the riverbank at the Chemtech site.

5.0 SOIL SAMPLING

5.1 Objectives of the Soil Sampling Program

Previous soil sampling conducted at the facility has identified various chemicals to be present in the soils. To identify the source area(s) and obtain a better understanding of soil stratigraphy, additional soil sampling will be conducted. The proposed work will also quantify the concentrations in the soil, the vertical and lateral extent of any soil contamination, and obtain the data required to develop a RAP, if one is deemed necessary. The areas to be investigated will include: the former Tank Farms 6 through 14; the location of a reported underground storage tank (UST) adjacent to Tank Farm 1; and the site of a stormwater clarifier near the facility's maintenance building. Additional information and the activities proposed for these areas are presented below. No soil sampling is proposed on the Steel Casting property, as a soil remediation program approved by the MDNR removed the contaminated soil in 1995.

In addition to the soils being investigated in the three identified areas, soils from the proposed groundwater monitoring wells will be evaluated for contamination (see Section 6.0 and Figure 5-1 for the locations of the monitoring wells). The analytical schedule for these soil samples is given in Table 5-1. All soil sampling will be conducted in accordance with the procedures presented in the QAPP and SOP. The QA/QC protocols are also given in the QAPP.

5.1.1 Tank Farms 6 through 14

In 1997, 18 of the 19 storage tanks that had been in Tank Farms 6 through 14 were removed and relocated to the two new tank farms in the southern portion of the property. A single tank remains in Tank Farm 13. The old tank farms were constructed with earthen floors and cement walls for secondary containment. With the exception of a release of caustic soda

from Tank 28 in 1996 and a toluene/xylene release from Tank 7 observed during the moving of the tank, no releases of concern are documented to have occurred in this area. However, to evaluate the former tanks as potential sources of contamination, shallow soil sampling will be conducted in the area of the removed tanks.

Using historical records and information obtained from facility employees, a soil sample will be collected at the transfer valve of each of the former tank sites and the remaining tank in Tank Farm 13. Each sample will be collected from a depth of approximately three feet below ground surface (bgs). If contamination is observed in the field, a deeper sample may also be collected for analysis. Field screening of the samples will include headspace analysis with an organic vapor meter (OVM), odor, visual examination, and pH screening of moistened soil with pH paper. All of the samples collected at three feet will be analyzed regardless of the results of the field screening. Additional work may also be proposed in the future based on the results of the laboratory analyses. Laboratory analytical methods will be based on the contents of the tanks which were at each sampling location. The proposed analyses for each tank location are presented in Table 5-2.

5.1.2 Underground Storage Tank

A diesel fuel UST is reported to have been present in the area south of Tank Farm 1, adjacent to the facility office. The tank was taken out of service and filled with concrete in 1985. The tank was removed from the ground in 1990. However, no records or sampling results associated with its removal have been located. To determine if any environmental impairment resulted from the UST and further assess contamination at the site, one borehole will be drilled

to the water table in this area to assess soil stratigraphy and evaluate any subsurface contamination. The location of the borehole (MW8) is shown in Figure 5-1.

Based on head space analyses with an OVM, odor, and visual examination, two soil samples will be collected for laboratory analysis. Each sample will be analyzed for total petroleum hydrocarbons-extractable by EPA Method 8015E and VOCs by EPA Method 8260.

5.1.3 Stormwater Clarifier

A stormwater clarifier is located in the area south of the facility's maintenance building on the east side of the property. To determine if any environmental impairment resulted from the stormwater clarifier and assess any contamination along the southern boundary of the original Chemtech property, one borehole will be drilled to the water table in this area to assess soil stratigraphy and evaluate any subsurface contamination. The location of the borehole (MW13) is shown in Figure 5-1.

Based on head space analyses with an OVM, odor, and visual examination, two soil samples will be collected for laboratory analysis. Each sample will be analyzed for total petroleum hydrocarbons-extractable by EPA Method 8015E and VOCs by EPA Method 8260.

5.2 Soil Sampling Methodology

All borings will be drilled using hollow stem auger drilling methods, (see QAPP and SOP-004). To obtain a complete understanding of the soil stratigraphy, borings MW6, MW9, MW12, and MW13 will be continuously cored (see QAPP and SOP-016). The remaining borings will be sampled at five-foot intervals. Soil samples for possible laboratory analysis will be collected in pre-cleaned brass or stainless steel liners or laboratory supplied glass jars. Upon

collection, each sample will be appropriately labeled and placed in a cooler for submittal to the laboratory.

5.3 Sediment Sampling

Near-shore river sediment sampling will be conducted to evaluate the potential of contaminants migrating off the site and into the Mississippi River. In accordance with the protocols presented in the QAPP and SOP-015, river sediment samples will be collected at locations upstream and downstream of the Chemtech facility. The actual locations will be determined in the field, based upon river accessibility and safety. The sediment samples will be analyzed for pH, VOCs by EPA Method 8260, and SVOCs by EPA Method 8270.

6.0 GROUNDWATER SAMPLING

6.1 Objectives of the Groundwater Sampling Program

Both volatile and semi-volatile organic compounds have been reported in all five groundwater monitoring wells at the facility. Although the SVOCs were found only at low levels, the VOCs have been found at levels of concern. Since April 1992, regular groundwater monitoring of all five existing wells has been conducted, during which high levels of VOCs have been reported. The compounds of particular concern have been benzene, toluene, xylenes, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene.

The objective of the groundwater investigation will be to define the extent of the migration of the contamination, determine the concentrations, quantify the contaminant load, and obtain the data required to develop a RAP, if one is deemed necessary. To obtain this information, monitoring wells will be installed and groundwater samples will be collected for analysis. All well installation and groundwater sampling will be conducted in accordance with the procedures presented in the QAPP and SOP. Well installation will also comply with Missouri Well Construction Rules and will be installed by contractors licensed in the State of Missouri.

6.2 Monitoring Well Installation and Groundwater Sampling

A total of eight new groundwater monitoring wells will be installed at the facility. This will include monitoring wells at the former UST and stormwater clarifier sites discussed in the preceding section, and six additional groundwater monitoring wells. The locations of the new monitoring wells are shown in Figure 5-1. The purpose of the wells will be to assist in the delineation of the groundwater contamination and to monitor groundwater quality migrating on to the site.

Monitoring wells MW6, MW7, MW10, and MW13 will be installed in boreholes drilled to the limestone bedrock, a depth of approximately 42 feet. Well construction will comply with the Missouri Well Construction Rules in Chapter 4, 10CSR 23 - 4.060, and with RSMo 256.600-640. Well materials will be Schedule 40 two-inch diameter polyvinyl chloride. The sand filter will extend to two feet above the well screen. A three-foot bentonite pellet seal will be placed in one-foot lifts with hydration above the sand filter except in wells MW9 and MW12 which will have the bentonite seal in the saturated zone. In these two wells, hydration will not be necessary. A bentonite slurry grout will be placed from the seal to the protective casing. The screen interval will be from 10 feet below grade to the bottom of the well. MW8 and MW11 will be drilled to depths of 25 feet. The screen interval will be from 10 feet to the bottom of the well. These wells will preferentially test for light phase chemicals. Wells MW9 and MW12 will be installed adjacent to MW8 and MW11, respectively. These wells will be installed in boreholes drilled to the bedrock. The wells will be screened across the lower 10 feet only. These wells will selectively test for dense phase components. Typical monitoring well construction is shown in Figure 5-2. Well installation and development of the wells will be conducted in accordance with the protocols presented in the QAPP and SOPs 004 and 013. The rationale for the location of each monitoring well is given in Table 6-1.

Following installation and development of the wells, ground water will be sampled following the protocols in the QAPP and the relevant SOPs. Each new well will be sampled and analyzed based upon former activities in that area. The proposed groundwater analyses for each of the newly installed wells is presented in Table 6-2. The groundwater sampling parameters may be revised based upon the initial results.

6.3 Groundwater Monitoring

The new monitoring wells will be incorporated into a site wide groundwater monitoring program. The sampling will initially be conducted on a quarterly basis. The purpose of the monitoring will be to evaluate groundwater flow direction and quality. The program will consist of sampling a total of 13 onsite wells. These wells include the eight new monitoring wells and the five existing wells. Because some of the contamination on the Coast Guard site appears to have resulted from Coast Guard activities, an inquiry will be made into Coast Guard plans for additional monitoring at the site. Any additional monitoring results obtained from the Coast Guard will be incorporated into the Chemtech data evaluation. If the Coast Guard does not plan to undertake further evaluation, a request will be made to collect samples from monitoring wells MW-4, MW-5, MW-6, and MW-9 on the Coast Guard property. The locations of all the wells are shown in Figure 5-1. The proposed groundwater analyses for each of the wells within the program are presented in Table 6-2. Following the first groundwater monitoring event, a review of the data collected will be undertaken to determine which parameters will be included in the quarterly monitoring program. The need for quarterly sampling will be reviewed at the end of the first year of the program. The results, findings, and any changes proposed related to future monitoring events will be presented in quarterly monitoring reports.

6.4 Measurement of Aquifer Characteristics

Associated with the first round of sampling, all wells incorporated into the monitoring program will be vertically and horizontally surveyed to a common bench-mark. This data will be used in the monitoring of groundwater flow direction and hydraulic gradient. Following this, a minimum of eight slug tests will be conducted to estimate the hydraulic conductivity of the

aquifer under the site. The slug tests will be conducted by placing pressure transducers in the selected wells to evaluate both rising and falling head situations using the largest possible slug. The transducers will be monitored by using a data logger to obtain continuous readings.

6.5 Riverbank Seep Monitoring

Chemicals have been observed seeping from the river bank into the river at the Coast Guard property, particularly when the water level in the river is low. Similar seepage has not been observed on the Chemtech facility. However, the current inspection program to detect seeps from the Chemtech property will continue on a daily basis. If any seeps are observed, a sample of the seep will be collected for laboratory analysis. Samples will also be collected upstream of the seep and at the downstream side of the Chemtech property. All samples collected will be analyzed for VOCs by EPA Method 8260 and pH by EPA Method 150. The results of the visual inspections and any laboratory analysis will be documented in the corresponding quarterly groundwater monitoring report.

The reason or source for the seep on the USCG property is not known. There appears to be a conduit for contaminated ground water in the area of the seep. Chemtech will seek the assistance of the Coast Guard to determine if any man-made structures are responsible for the preferential flow. If a structure such as a sewer, either the pipe itself or permeable fill around the pipe, is found to be contributing to the problem, appropriate actions will be taken to help minimize further releases.

7.0 ADDITIONAL STUDIES

7.1 Objectives of the Additional Studies

To fully evaluate environmental concerns at the Chemtech St. Louis facility, additional studies will be conducted. These will include: air sampling, identification of potential receptors, identification of sensitive environments, and location of drinking water sources. With the exception of air sampling, the additional studies will be limited to data base searches, file reviews, and discussions with the regulatory agencies and other knowledgeable persons. These studies are described further in Section 8.0, Risk Assessment.

7.2 Air Monitoring

Air monitoring will be used to evaluate air quality at the site, and the impact to adjacent sites. The fugitive emissions from the facility will be determined by collecting air samples from the upwind and downwind boundaries of the facility, (SOP-017). The samples will be taken under prevailing wind conditions. Samples will be collected from the breathing zone using Summa (stainless steel) canisters. Air samples will be analyzed using Method TO-14 (see QAPP and SOP-017) with the inclusion of acetone in the analytical schedule.

8.0 RISK ASSESSMENT

8.1 Objectives of the Risk Assessment

The objective of the risk assessment is to define the current and potential risks to human health and the environment. The risk assessment may also be used to help determine the scope of any remedial actions which may be necessary at the site.

8.2 Risk Assessment Investigation

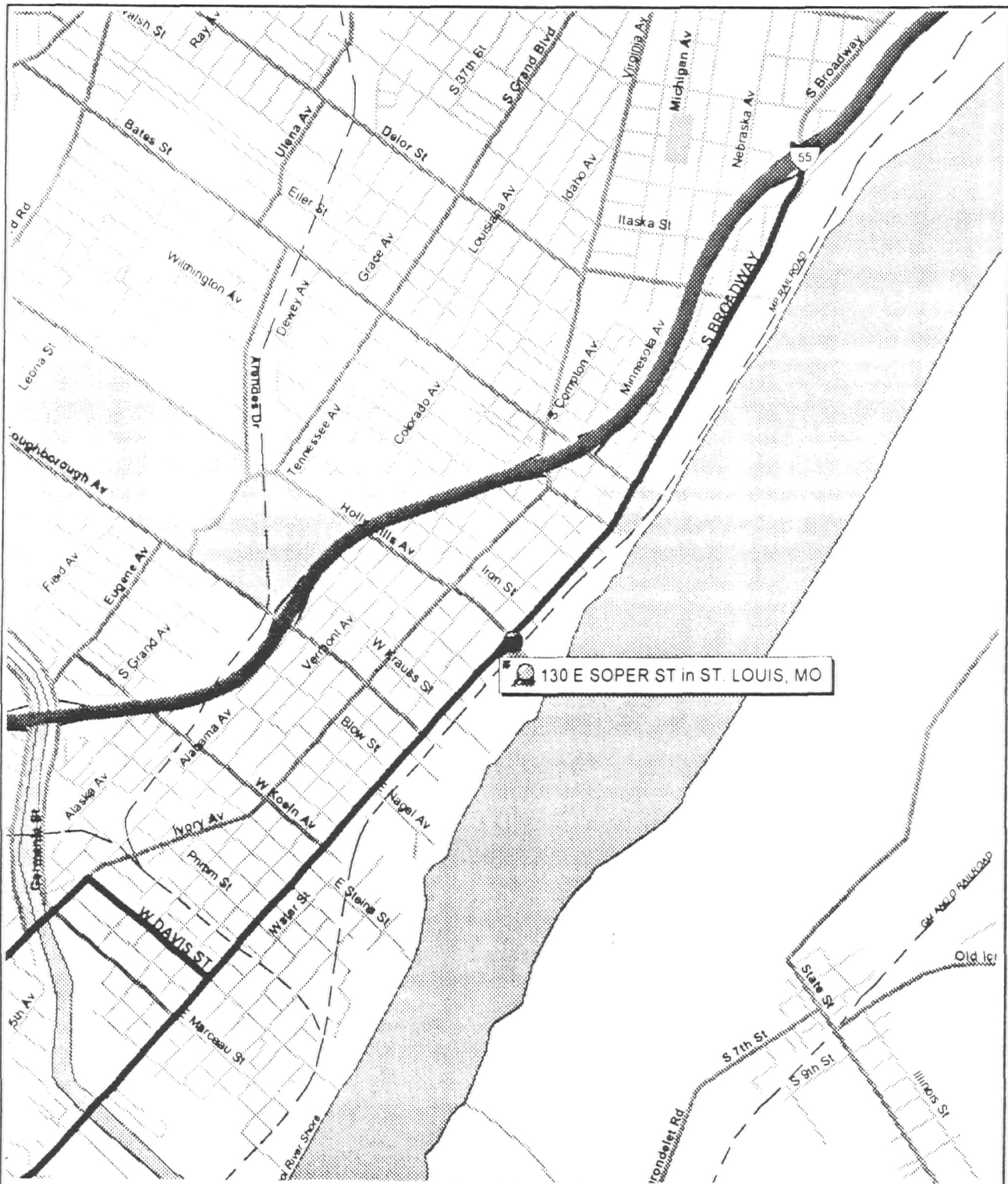
The data required for the risk assessment either have been obtained in previous studies or will be obtained by the studies proposed in this workplan. Additional data which must be obtained includes: (1) the pathways for exposure; (2) the potential receptors; (3) the air quality at the boundaries of the facility; and (4) the chemicals which will be used for the risk assessment model. The pathways for exposure and the potential receptors will be determined by the results of the soil and groundwater investigations, by the results of the air sampling at the perimeter of the facility, by identifying the populations which could be affected by the contamination, and by an analysis of the threat posed by the chemicals in the soil and ground water by a qualified toxicologist.

When all of the data necessary for the risk assessment have been obtained, the risk posed by the chemicals and, if appropriate, an alternative cleanup level will be determined by a qualified risk assessor using the Risk Assessment Guidelines for Superfund.

9.0 SCHEDULE

The schedule for implementation of the RI is given in Figure 9-1. The onset of work will be dependent on the date of approval of the workplan by MDNR and EPA. Should the need for additional work be discovered during the performance of the RI, the schedule will be modified as appropriate with the approval of MDNR and EPA.

Figures



CLIENT: Chemtech

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12/17/97

REVISED:

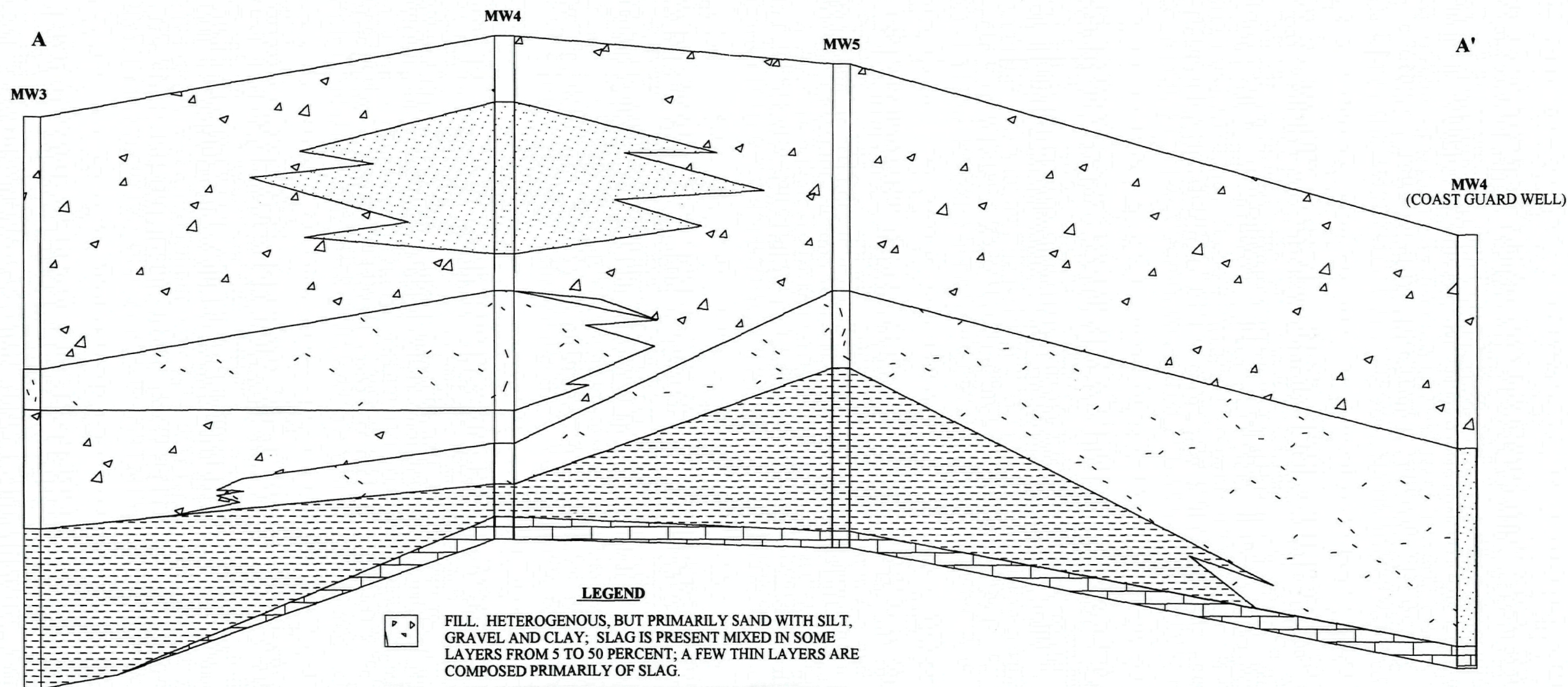
Figure 2-1. Location of the Chemtech St. Louis Site

Scale: 1 in. = 2000 feet






0 1000 2000 4000 6000 8000



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LEGEND

-  FILL. HETEROGENOUS, BUT PRIMARILY SAND WITH SILT, GRAVEL AND CLAY; SLAG IS PRESENT MIXED IN SOME LAYERS FROM 5 TO 50 PERCENT; A FEW THIN LAYERS ARE COMPOSED PRIMARILY OF SLAG.
-  SAND. RANGES FROM FINE TO COARSE WITH VARIABLE AMOUNTS OF SILT, CLAY AND VERY MINOR FINE GRAVEL CLASTS; SLAG TYPICALLY ABSENT, MAY BE PRESENT IN MINOR AMOUNTS.
-  SILT. FINE TO COARSE SILT WITH CLAY AND FINE TO COARSE SAND; TYPICALLY WELL COMPACTED.
-  CLAY. BLACK TO DARK GRAY, SOFT; SILT AND SAND IN SOME LAYERS; LAYERS BETTER DEFINED THAN IN OVERLYING UNITS; ONLY VERY MINOR AMOUNTS OF SLAG DESCRIBED AS PRESENT.
-  LIMESTONE. TYPICALLY WITH A THIN WEATHERED SURFACE BUT APPARENTLY WELL CONSOLIDATED BEDROCK BELOW THE WEATHERED SURFACE.

THE LOCATION OF LINE A-A' IS SHOWN IN FIGURE 2-2
VERTICAL EXAGGERATION IS 5X

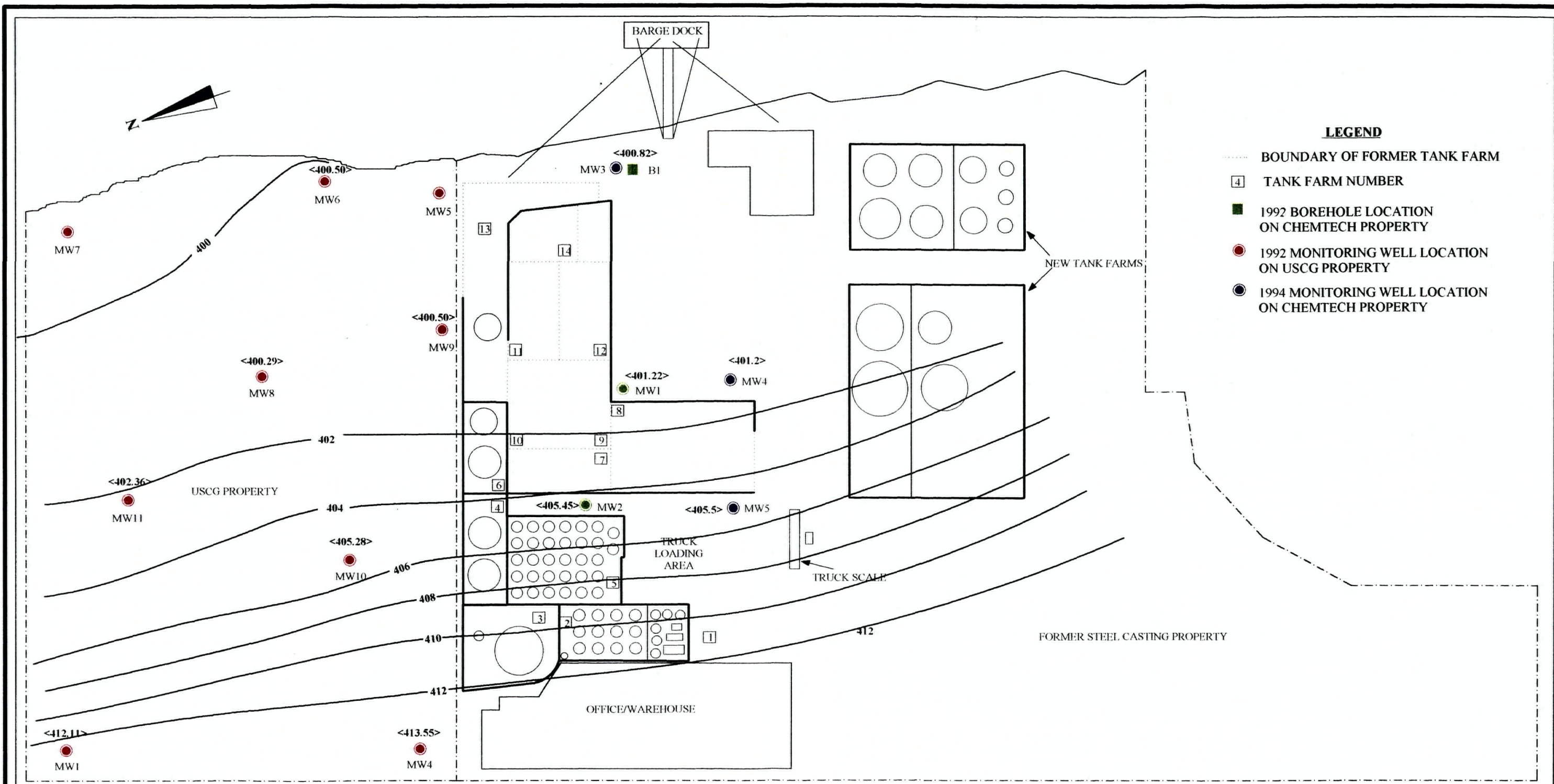
CLIENT:
Chemtech
DRAWING CREATED:
12/15/97
REVISED:
4/8/98

Figure 2-3. Cross Section Showing the Soil Stratigraphy
Along an East-West Line (A-A')

Horizontal Scale: 1 in. = 50 feet
0 25 50 100 150 200

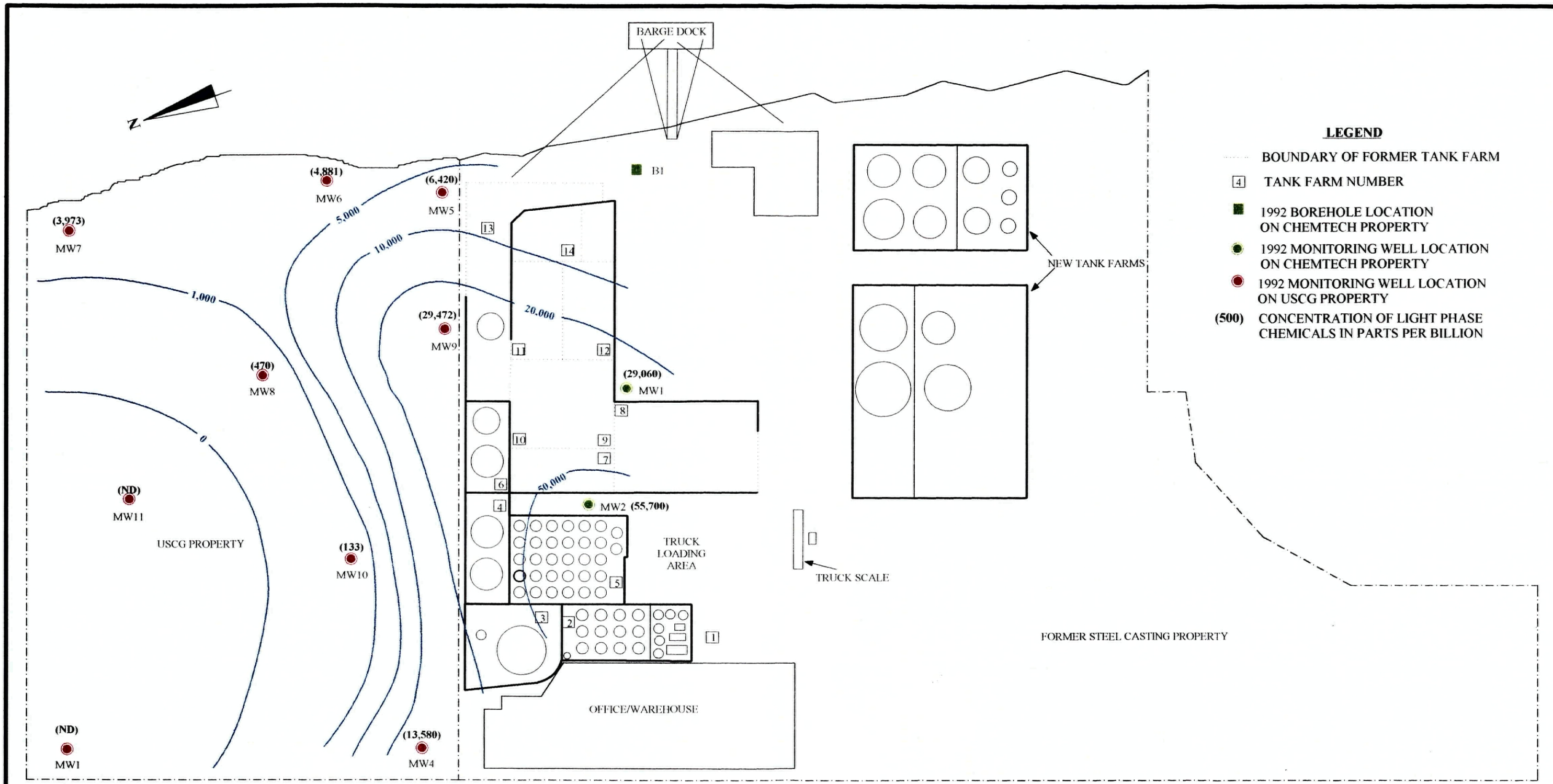
Vertical Scale: 1 in = 10 feet

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- LEGEND**
- BOUNDARY OF FORMER TANK FARM
 - [4] TANK FARM NUMBER
 - 1992 BOREHOLE LOCATION ON CHEMTECH PROPERTY
 - 1992 MONITORING WELL LOCATION ON USCG PROPERTY
 - 1994 MONITORING WELL LOCATION ON CHEMTECH PROPERTY

CLIENT: Chemtech	<p>Figure 2-4. Groundwater Elevation Contours, 1992</p> <p>Scale: 1 in. = 100 feet</p> <p>0 50 100 200 300 400</p>	<p>CJE</p>
DRAWING CREATED: 12/04/98		
REVISED:		

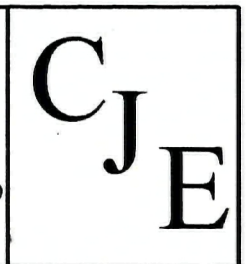


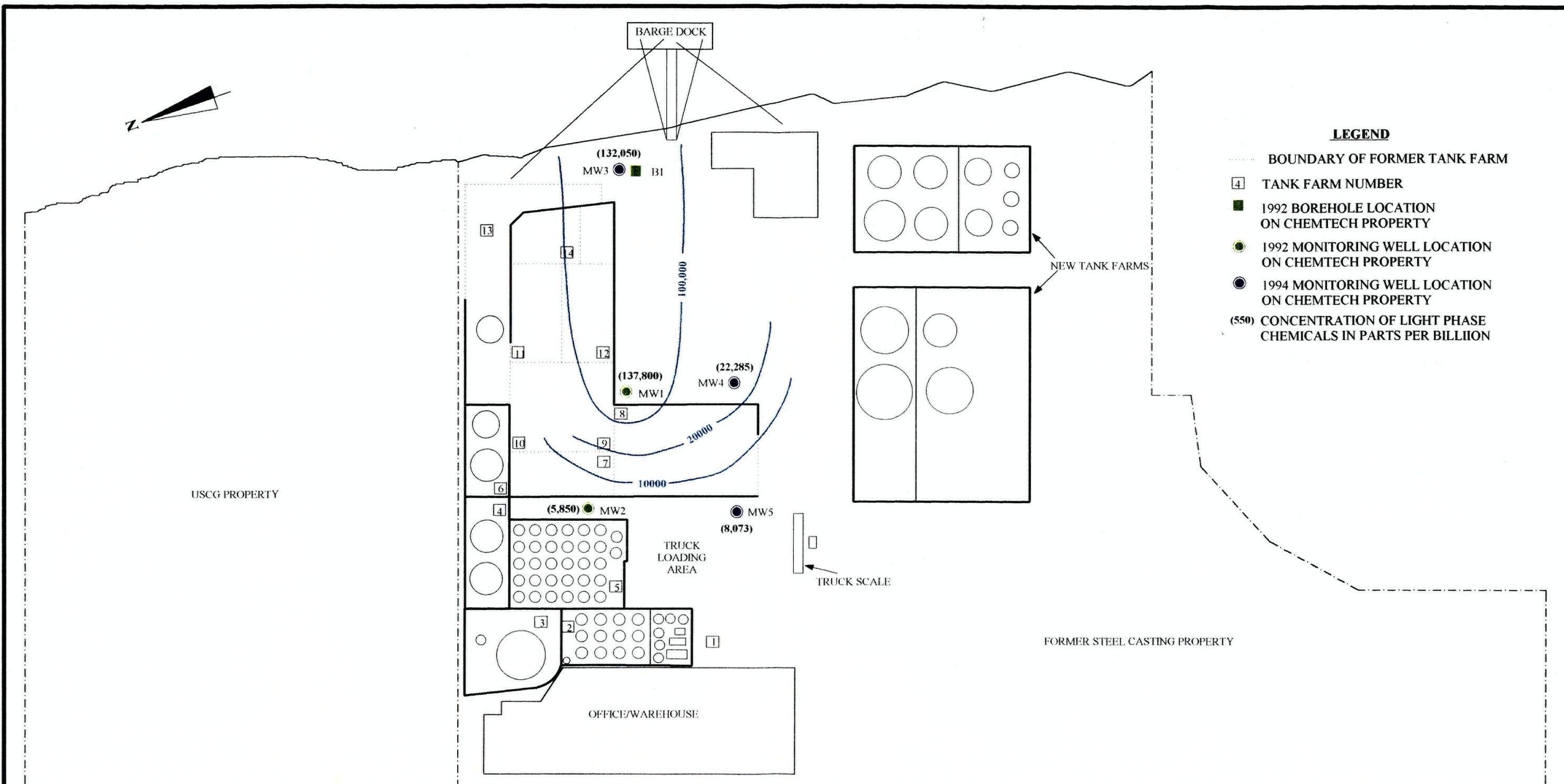
CLIENT: Chemtech
 DRAWING CREATED:
 12/04/98
 REVISED:

Figure 4-1. Contours Showing the Extent of Light Phase Solvents and Acetone in the Ground Water in 1992

Scale: 1 in. = 100 feet

0 50 100 200 300 400





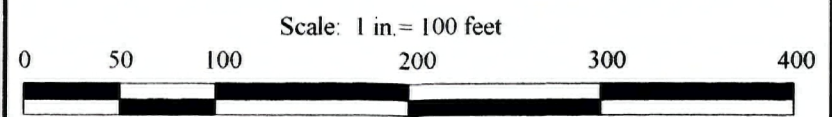
- LEGEND**
- BOUNDARY OF FORMER TANK FARM
 - [4] TANK FARM NUMBER
 - 1992 BOREHOLE LOCATION ON CHEMTECH PROPERTY
 - 1992 MONITORING WELL LOCATION ON CHEMTECH PROPERTY
 - 1994 MONITORING WELL LOCATION ON CHEMTECH PROPERTY
 - (550) CONCENTRATION OF LIGHT PHASE CHEMICALS IN PARTS PER BILLION

CLIENT: Chemtech

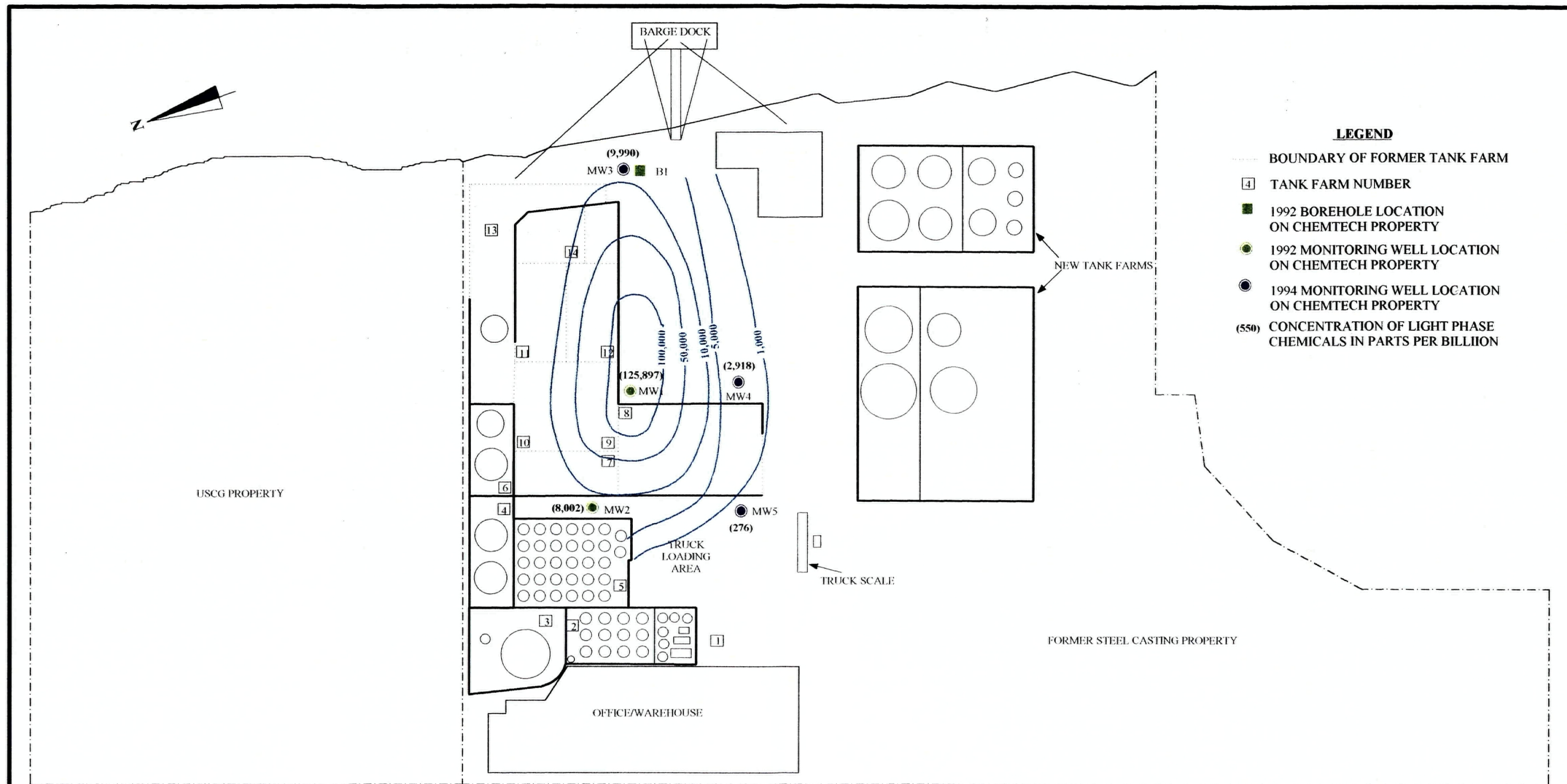
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Figure 4-2. Contours Showing the Extent of Light Phase Solvents and Acetone in the Ground Water in 1994



CJ E



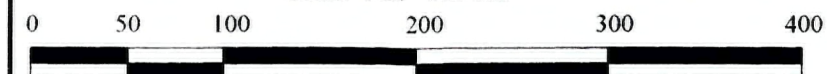
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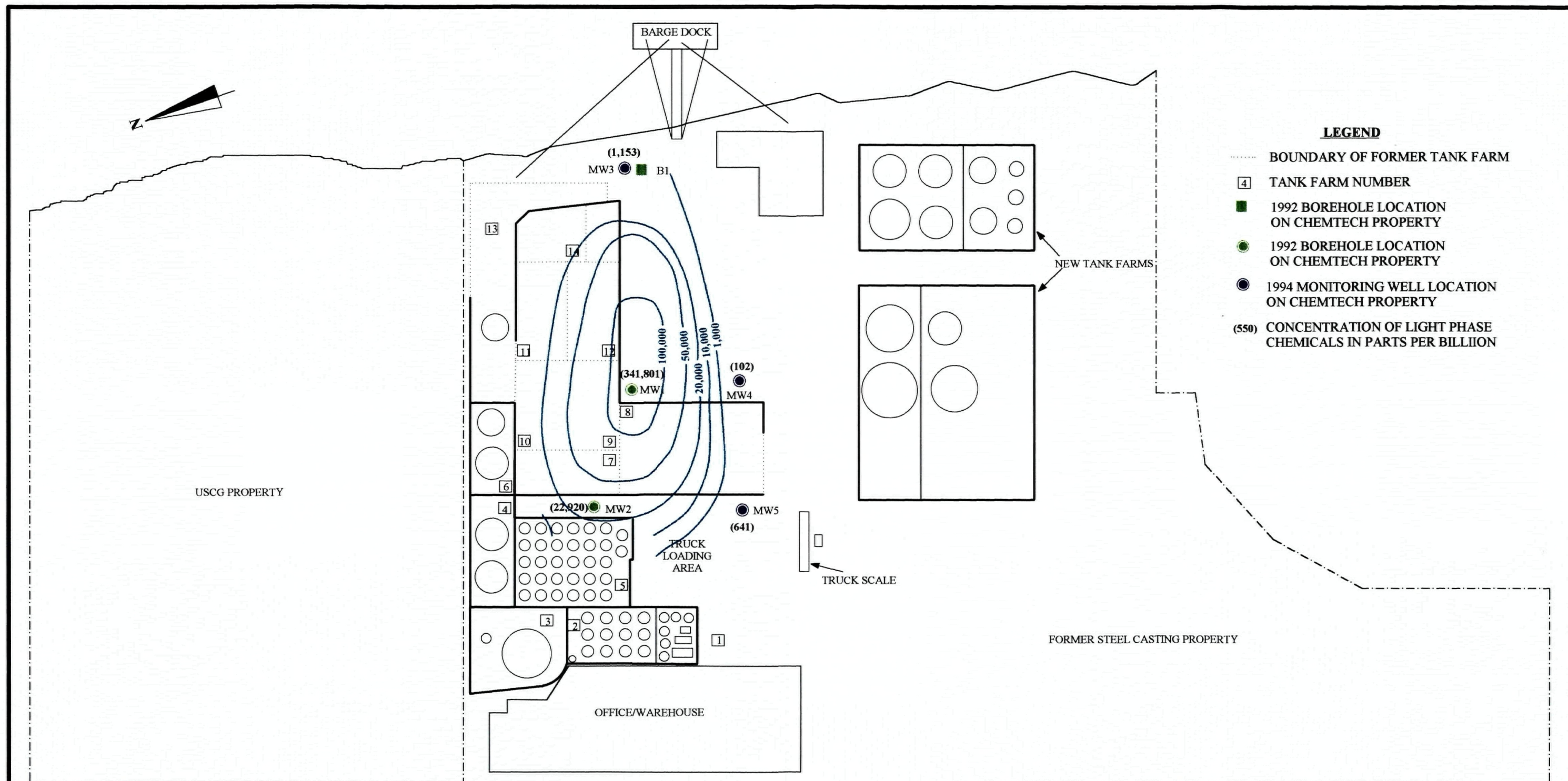
REVISED:
6/19/99

Figure 4-3. Contours Showing the Extent of Light Phase Solvents and Acetone in the Ground Water in 1996

Scale: 1 in. = 100 feet



CJ
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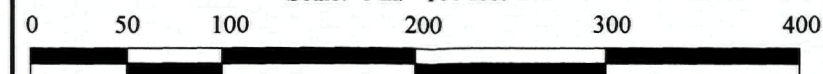
CLIENT: Chemtech

DRAWING CREATED:
12/05/98

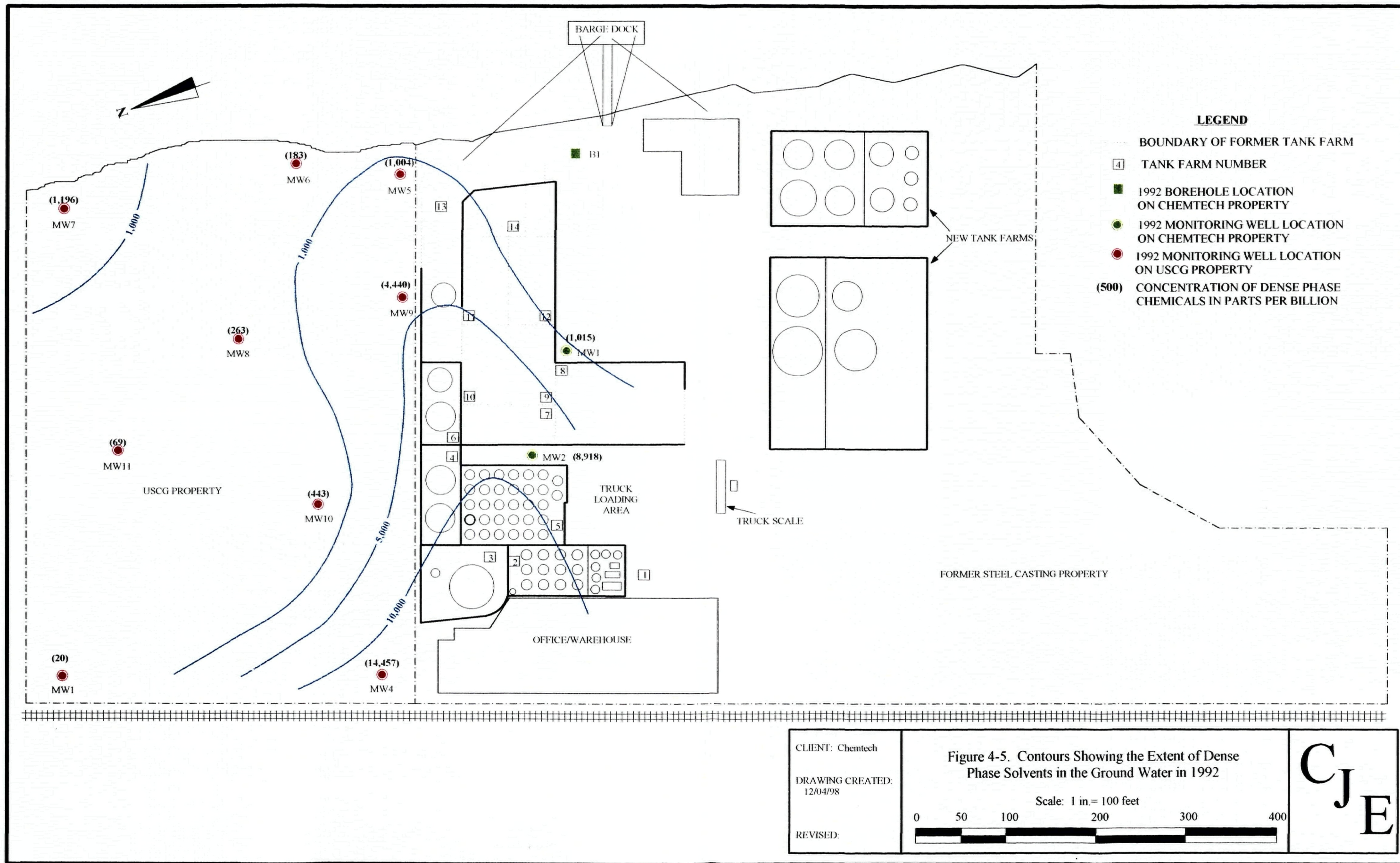
REVISED:

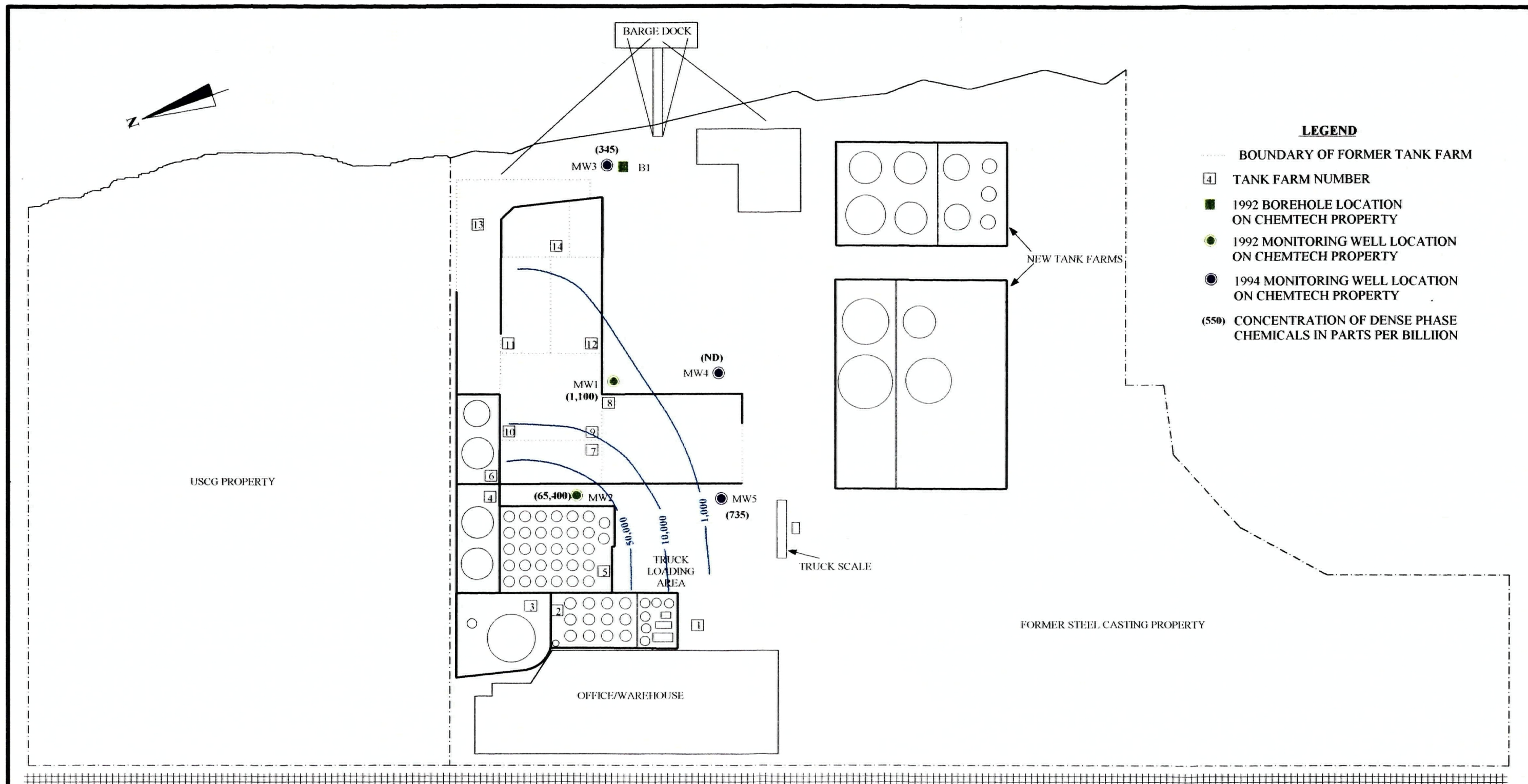
Figure 4-4. Contours Showing the Extent of Light Phase Solvents and Acetone in the Ground Water in 1998

Scale: 1 in. = 100 feet



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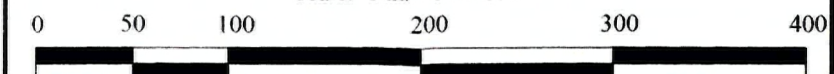
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DRAWING CREATED:
12/05/98

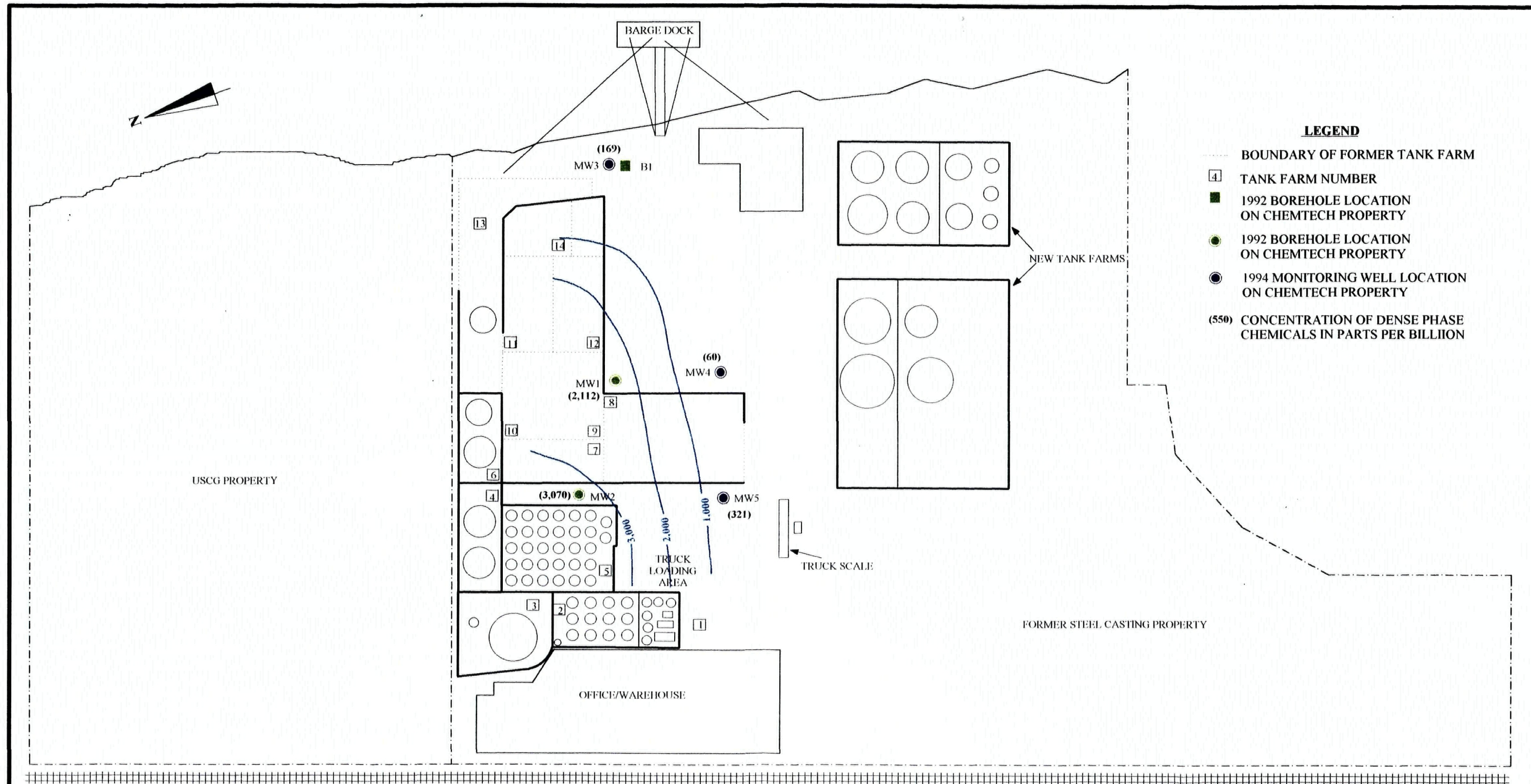
REVISED:
6/19/99

Figure 4-6. Contours Showing the Extent of Dense Phase Solvents in the Ground Water in 1994

Scale: 1 in. = 100 feet



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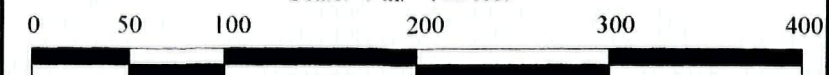
CLIENT: Chemtech

DRAWING CREATED:
12/05/98

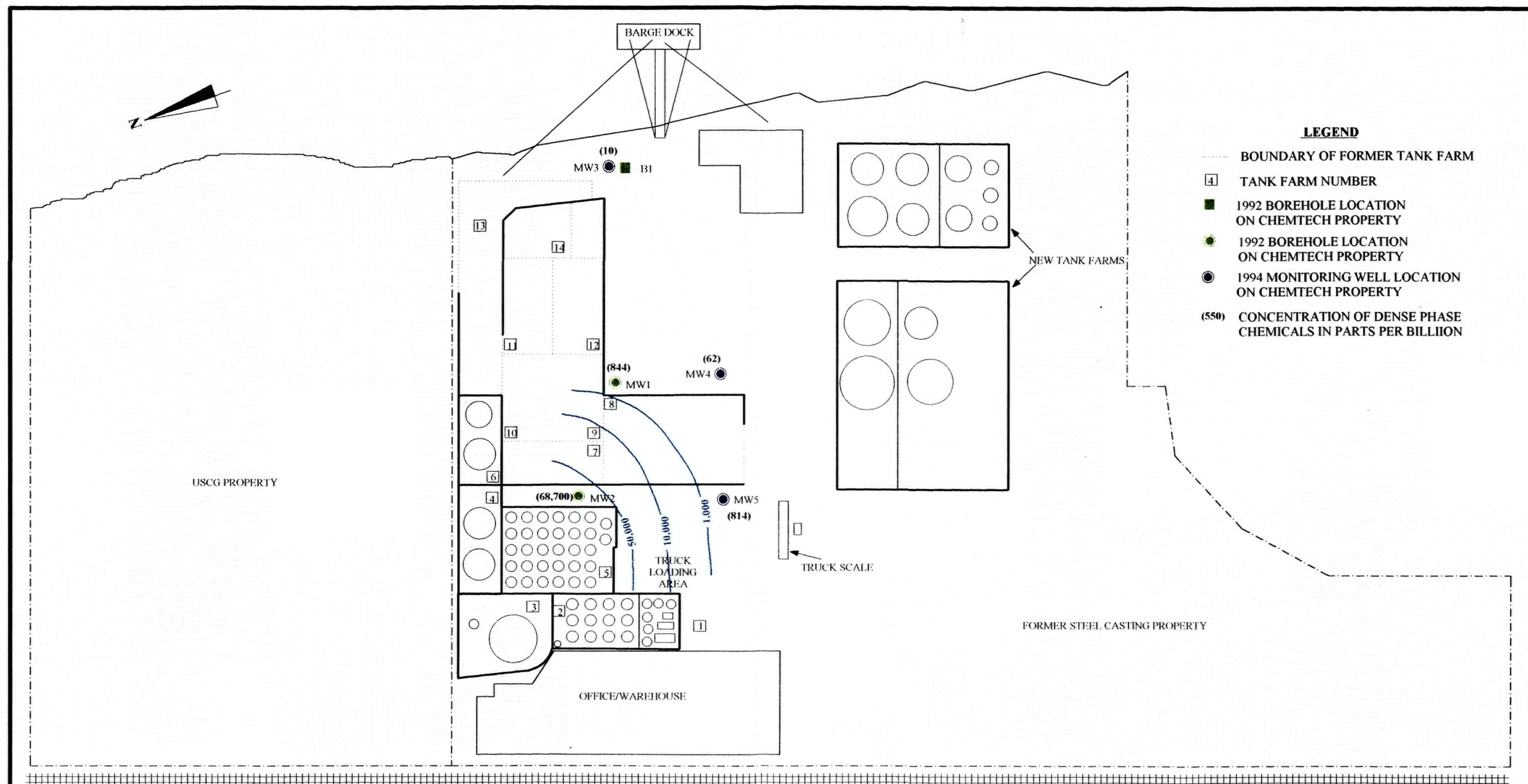
REVISED:

Figure 4-7. Contours Showing the Extent of Dense Phase Solvents in the Ground Water in 1996

Scale: 1 in. = 100 feet



CJE



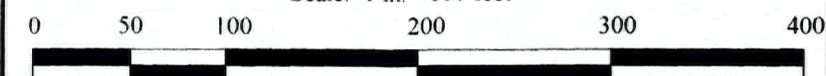
CLIENT: Chemtech

DRAWING CREATED:
12/05/98

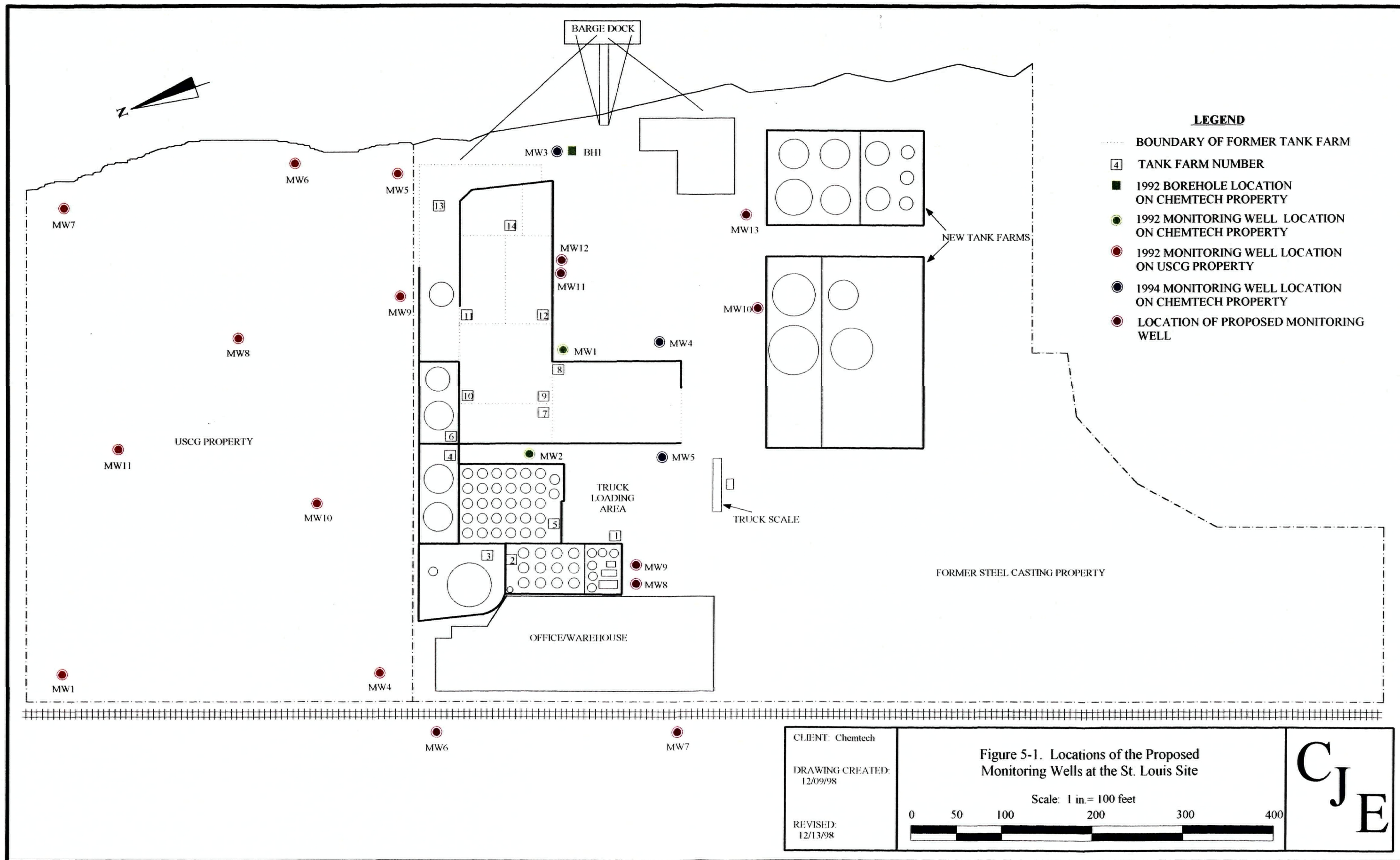
REVISED:

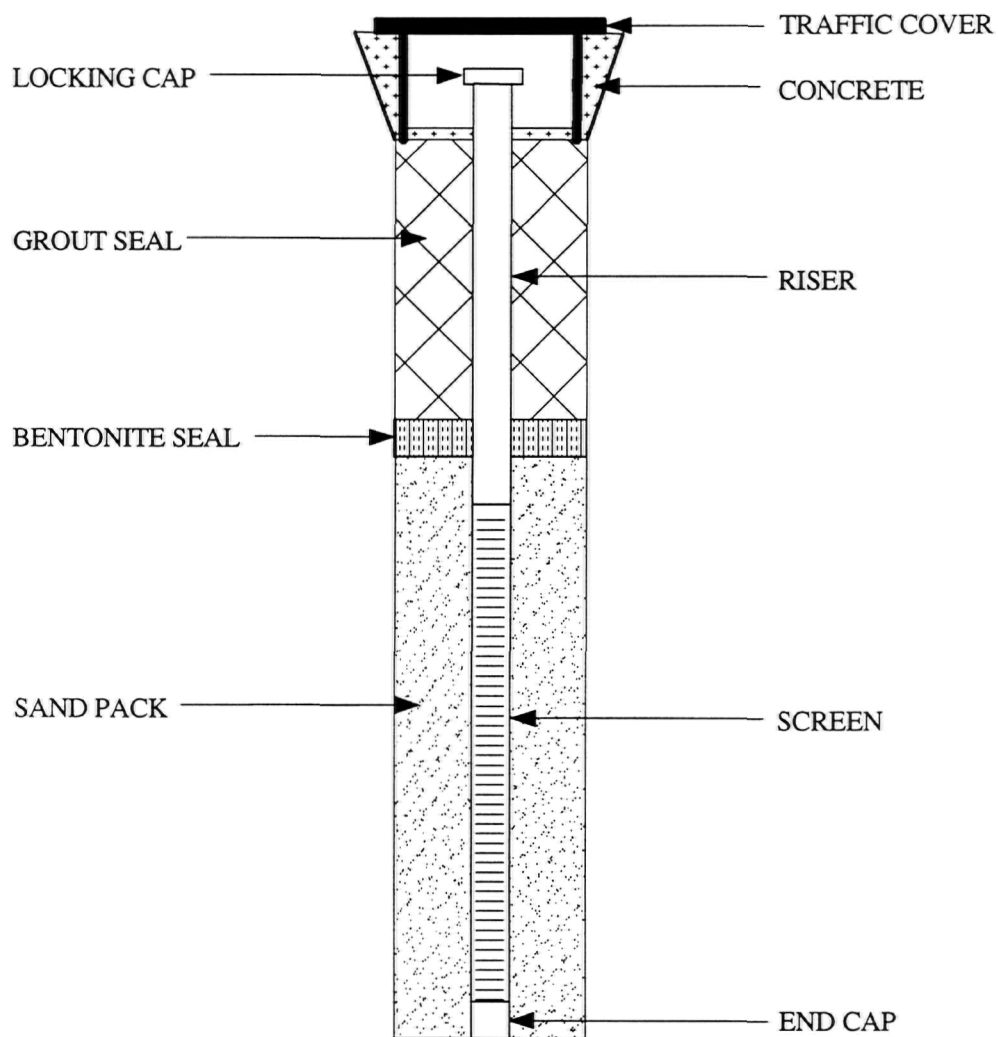
Figure 4-8. Contours Showing the Extent of Dense Phase Solvents in the Ground Water in 1998

Scale: 1 in. = 100 feet



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CLIENT:
CHEMTECH

DRAWING CREATED:
11/16/98

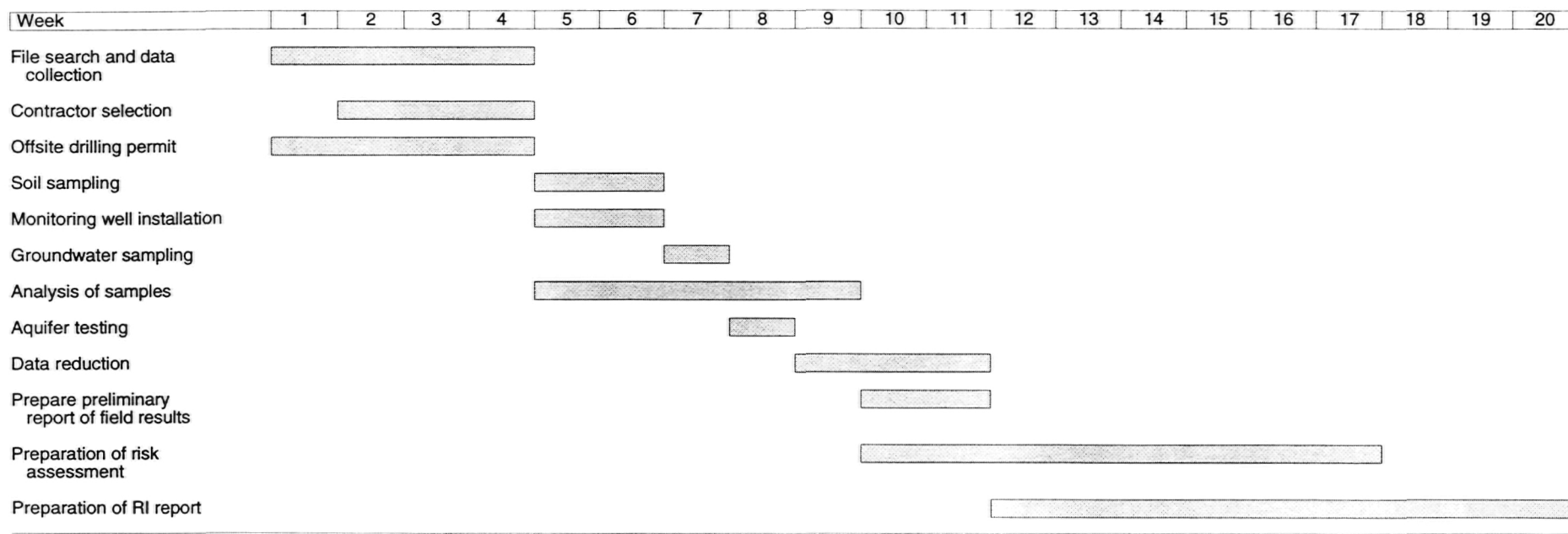
REVISED:

Figure 5-2. Typical Monitoring Well Construction

No Scale

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FIGURE 9-1. SCHEDULE OF WORK



TABLES

TABLE 3-1
STORAGE TANK AND PRODUCTS
AT THE ST. LOUIS FACILITY
NOVEMBER 1998

Tank	Capacity	Product
1	310,000	Potash
2	310,000	Caustic Soda 50% Reg.
3	221,000	Avgas (Air BP)
4	420,000	Empty
5	380,000	0148 Aro 200
6	380,000	Empty
7	620,000	Reichold Mineral Spirits
8	620,000	Caustic Soda Membrane
9	210,000	Caustic Potash
10	20,000	Caustic Potash
15	450,000	Empty
16	450,000	Aromatic 200 (Mineral Spirits)
22	50,000	Shell Sol 142 (MS)
23	50,000	C-145 Flash (MS)
26	50,000	Aromatic 100 (MS)
27	815,000	Alkylate
28	420,000	Caustic Soda 50% Rayon
29	630,000	Methanol
30	450,000	Caustic Soda 50% Reg.
31	30,000	Methyl Ethyl Ketone
32	30,000	Xylene
33	30,000	Therminol
34	30,000	IPA 99%
35	30,000	LPA 170 (Parafin/Naphtha)
36	20,000	P Amyl Acetate
37	20,000	EE Acetate Low Moisture
38	20,000	Normal Butyl Alcohol
39	20,000	Mineral Spirits NC
40	20,000	Mineral Seal Oil
41	20,000	Ethyl Acetate 99%
42	20,000	EB Acetate
43	20,000	Shell Sol 142
44	20,000	N-Hexane
45	20,000	Econo Blend
46	20,000	S.D. Alcohol 3C Anhydrous
47	20,000	N Butyl Acetate
48	20,000	Heptane C
49	20,000	Acetone

TABLE 3-1 (Continued)

Tank	Capacity	Product
50	20,000	Shell Sol 71(MS)
51	20,000	Toluol
52	20,000	Chemsolv EB (Ethyl Glycol Monobutyl Ether)
53	20,000	VM&P UNOCAL (Naphthalene)
54	20,000	Mineral Spirits
55	11,600	Acetone
56	20,000	P Amyl Acetate
57	20,000	N-Hexane
58	12,000	Methlene Chloride
59	12,000	S.D. Alcohol - 3A Anhydrous
60	5,000	Shell Sol 340 (MS)
61	10,000	Empty
64	8,500	Empty
65	15,000	Midco Hitech Premix
67	20,000	Empty
68	10,000	Empty
69	5,000	Empty
70	5,000	Empty
71	5,000	Empty
72	8,000	Empty
73	10,000	Empty
74	12,000	Empty
75	8,000	Empty
76	12,000	Empty
77	12,000	Empty
78	8,000	Empty
79	12,000	Empty
80	12,000	Normal Butyl Alcohol
81	7,884	Empty
82	5,000	EB Acetate
83	12,000	Empty
84	8,000	Surfactant 9.5 mole
85	12,000	Sulfuric Acid
86	12,000	Sulfuric 66 Tech
88	16,480	Muriatic Acid 20
90	1,000	Nitric 42
91	8,400	Empty
92	5,765	Phosphoric Acid Tech

TABLE 4-1
RESULTS OF CHEMICAL ANALYSES OF SOIL SAMPLES
HCI - CHEMTECH - ST. LOUIS
JULY 1985

Analyte	Sample Number									
	14	15	16	17	18	19	20	21	22	23
Acetone	ND	300	ND	170	ND	ND	180	181	ND	ND
Methylene chloride	ND	110	21,000	64	ND	ND	46	76	ND	ND
Methyl ethyl ketone	ND	ND	13,000	ND	ND	ND	ND	ND	ND	ND
Toluene	19,000	ND	2,500	ND	165,000	300,000	ND	ND	1,100,000	29,000
Xylene	600,000	ND	2,800	19	400,000	640,000	18	ND	74,000	ND
TOX ¹	28	<10	16	<10	42	190	<10	<10	<10	40
pH	7.8	8.9	7.2	8.5	8.0	7.1	4.5	5.7	11.2	9.1

All results in ug/L (ppb)

ND - Not Detected

1 - No further definition given

TABLE 4-2
RESULTS OF CHEMICAL ANALYSES OF SOIL AND GROUNDWATER SAMPLES
HCI - CHEMTECH - ST. LOUIS
MAY 1992

Analyte	Soil			Water	
	MW1	MW2	VSB	MW1	MW2
Vinyl chloride	ND	ND	ND	53	650
Methylene chloride	14	35	ND	1.2	590
1,1-Dichloroethane	ND	450	ND	25	800
1,2-Dichlorobenzene	3,600	1,600	ND	310	2,400
Tetrachloroethylene	1,200	1,700	ND	99	770
1,1,1-Trichloroethane	ND	310	ND	ND	560
Chlorobenzene	ND	ND	ND	450	18
Benzene	1,000	ND	37	1,100	ND
Trichloroethene	200	6,500	280	71	2,100
Toluene	200,000	160,000	240	24,000	33,000
Ethylbenzene	2,200	7,000	890	560	2,700
1,1-Dichloroethylene	ND	ND	ND	5.8	310
Xylene	16,000	56,000	12,000	3,400	20,000

All results in ug/L (ppb)
 ND - Not Detected

TABLE 4-3
RESULTS OF CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES
U.S. COAST GUARD SITE
MAY 1992

Analyte	Monitoring Well								
	MW-1	MW-4	MW-5	MW-6	MW-7	MS-8	MW-9	MW-10	MW-11
Acetone	ND	1,280	1,900	2,080	3,100	276	20,500	ND	ND
Benzene	ND	500	29	39	153	18	278	92	ND
2-Butanone	ND	ND	2,600	1,050	ND	ND	ND	ND	ND
Chlorobenzene	ND	30	802	ND	237	ND	ND	32	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	48	ND
Chloromethane	20	20	178	95	26	9	ND	ND	55
1,2-Dichlorobenzene	ND	40	ND	24	13	ND	235	6	ND
1,1-Dichloroethane	ND	17	ND	22	113	40	284	150	ND
Cis-1,2-dichloroethene	ND	13,200	ND	ND	519	124	2,580	47	ND
Trans-1,2-dichloroethene	ND	50	ND	ND	17	ND	ND	ND	ND
Ethylbenzene	ND	1,120	60	120	109	27	1,200	5	ND
4-Methyl-2-pentanone	ND	ND	ND	37	ND	40	1,410	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	367	10	14
Toluene	ND	5,300	1,500	940	259	118	4,280	20	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	22	ND
Trichloroethene	ND	ND	24	42	18	23	974	128	ND
Vinyl chloride	ND	1,100	ND	ND	144	67	ND	ND	ND
Xylenes (Total)	ND	5,380	360	652	352	ND	1,804	16	ND
pH (Method 150.1)	6.63	6.73	11.90	11.68	9.77	9.08	11.71	9.36	6.77
TRPH (Method 418.1)	2.30	6.32	3.13	2.5	11.55	3.31	71.05	4.66	2.05

All results in part per billion
ND - Not Detected

TABLE 4-4

RESULTS OF CHEMICAL ANALYSES OF SOIL SAMPLES

HCI - CHEMTECH - ST. LOUIS

MARCH 1994

Analyte	Borehole (Depth in feet)						
	B-3 28-29.5	B-3 39-41	B-4 22	B-4 32	B-4 32 (DUP)	B-5 11-15	B-5 23-25
VOLATILE ORGANICS							
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	0.19
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	0.010	ND	ND	ND	ND	ND
1,4-Dichloro-2-butene	ND(J)	ND(J)	ND(J)	ND(J)	ND(J)	ND	ND
2-Butanone (MEK)	ND	ND	ND	0.074	0.097	ND	ND
2-Hexanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	0.5	0.63	4.3	ND
Benzene	31	0.81	0.4	0.14	0.038	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND(J)	ND	ND(J)	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	0.54	0.27	ND	ND
Methylbenzene (Toluene)	1.4	ND	0.4	1.2 D	1.0	0.81	0.08
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND
Cis-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND
Trans-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
M&P-Xylene	0.3	ND	0.8	2.0	1.1	0.44	ND
O-Xylene	0.5	ND	ND	0.69	0.42	0.17	ND
Naphthalene	ND	0.010 B(0.011)	ND	0.043 B(0.011)	0.035	0.10	ND
BASE NEUTRALS							
Bis(2-chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	0.32J	ND
Naphthalene	ND	ND	0.14J	ND	ND	0.42	ND
2-Methylnaphthalene	ND	ND	1.3	ND	ND	1.5	ND
Acenaphthylene	ND	ND	ND	ND	ND	0.074J	ND

TABLE 4-4 (Continued)

Analyte	Borehole (Depth in feet)						
	B-3 28-29.5	B-3 39-41	B-4 22	B-4 32	B-4 32 (DUP)	B-5 11-15	B-5 23-25
Acenaphthene	ND	ND	0.17J	ND	ND	0.19J	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	0.23J	ND	ND	0.46	ND
Phenanthrene	ND	0.23J	0.64	ND	ND	1.0	ND
Fluoranthene	ND	0.17J	0.098J	ND	ND	0.35	ND
Pyrene	ND	0.21J	0.11J	ND	ND	0.31J	ND
Benzo(a)anthracene	ND	0.091J	ND	ND	ND	0.11J	ND
Chrysene	ND	0.088J	ND	ND	ND	0.085J	ND
Bis(2-ethylhexyl)phthalate	ND	ND	ND	ND	1.7	2.3	ND
DISSOLVED RCRA METALS							
Arsenic	22	10	ND	71	62	ND	ND
Cadmium	ND	ND	ND	8.5	5.9	ND	ND
Chromium	25	15	ND	11	8.6	4.7	11
Lead	1.5J	11	ND	160	130	ND	11
Selenium	2.3J	ND(J)	2.6J	ND(J)	1.5J	2.4	ND
Barium	580	180	200	130	110	110	140
Mercury	ND	ND	ND	0.085	ND	ND	ND
pH VALUE - 10% SOLUTION:							
pH (pH units)	10.6	8.2	10.5	10.4	10.5	10.5	7.2

All results in mg/kg (ppm)

B(0.011) - Compound detected in the analytical blank at a concentration of 0.011 parts per million

D - Compound identified in analysis at a secondary dilution factor

J - Detected but below practical quantitation limit and above method detection limit

ND - Not Detected

TABLE 4-5

RESULTS OF CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

HCI - CHEMTECH - ST. LOUIS

MARCH 1994

Analyte	Monitoring Well					
	MW-1	MW-2	MW-2 (Dup)	MW-3	MW-4	MW-5
VOLATILE ORGANICS:						
1,1-Dichloroethane	ND	5,500	6,900	ND	ND(J)	ND
1,1-Dichloroethene	ND	300	400	ND	ND(J)	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND(J)	ND
1,4-Dichloro-2-butene	ND	ND	ND	ND	ND(J)	ND
2-Butanone (MEK)	ND	ND	ND	ND	ND(J)	600
2-Hexanone	ND	ND	ND	ND	ND(J)	ND
Acetone	ND	ND	ND	ND	ND(J)	11,000
Benzene	5,400	1,400	1,600	240,000D	300J	100
Chlorobenzene	500	ND	ND	ND	ND(J)	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND(J)	ND
Ethylbenzene	1,700	ND	ND	100	200J	100
Methylbenzene (Toluene)	20,000	1,800	1,900	500	2,700J	3,300
Tetrachloroethene	200	ND	ND	ND	ND(J)	200
Cis-1,2-dichloroethene	1,300	83,000D	90,000D	ND	ND(J)	500
Trans,-1,2-dichloroethene	ND	2,900	4,100	ND	ND(J)	ND
Trichloroethene	200	2,100	3,300	ND	ND(J)	200
M&P-Xylene	6,800	300	200	300	800J	700
O-Xylene	2,700	100	ND	200	300J	0.3
Naphthalene	100	ND	ND	ND	ND(J)	ND
BASE NEUTRALS:						
Bis(2-chloroethyl)ether	ND	690E	680E	ND	ND	4.3J
1,4-Dichlorobenzene	93	ND	ND	ND	ND	7J
1,2-Dichlorobenzene	480E	24	27	ND	3.9J	71
Naphthalene	160	28	32	6.2J	12	58
2-Methylnaphthalene	130	7.1J	9.1J	ND	9.3J	73
Acenaphthylene	ND	ND	ND	ND	ND	ND

TABLE 4-5 (Continued)

Analyte	Monitoring Well					
	MW-1	MW-2	MW-2 (Dup)	MW-3	MW-4	MW-5
Acenaphthene	25	ND	ND	3.2J	ND	2.8J
Dibenzofuran	13	ND	ND	ND	ND	ND
Fluorene	3.9J	ND	ND	ND	ND	3.7J
Phenanthrene	7.4J	ND	ND	ND	ND	5.8J
Fluoranthene	5.2J	ND	ND	ND	ND	ND
Pyrene	4.7J	ND	ND	ND	ND	ND
Chrysene	2.1J	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) Phthalate	16	ND	ND	ND	ND	ND
DISSOLVED RCRA METALS:						
Arsenic	180	270	280	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND
Barium	440	870	870	170	72	260
Mercury	ND	.5	ND	ND	ND	ND

D - Compound identified in analysis at a secondary dilution factor

E - Compound concentration exceeds calibration range

J - Detected but below practical quantitation limit and above method detection limit

ND - Not Detected

TABLE 4-6
HISTORICAL CHEMICAL ANALYSES OF GROUNDWATER SAMPLES
HCI - CHEMTECH - ST. LOUIS
MONITORING WELL MW1

Analyte	Date						
	4/92	3/94	12/94	12/95	9/96	5/97	1/98
Acetone	ND	ND	ND	ND	ND	290	810
Benzene	1,100	5,400	16,000	ND	4,700	1,900	9,800
Chlorobenzene	450	500	ND	ND	940	420	510
1,2-Dichlorobenzene	310	ND	ND	ND	400	ND	490
Cis-1,2-dichloroethene	ND	1,300	ND	ND	330	79	590
1,1-Dichloroethane	25	ND	ND	ND	34	22	65
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	5.8	ND	ND	ND	ND	ND	ND
Ethylbenzene	560	1,700	ND	ND	1,800	850	2,000
Methylene chloride	1.2	ND	ND	ND	2.7J	12	79
Methyl ethyl ketone	ND	ND	ND	ND	ND	ND	ND
Methyl isobutyl ketone	ND	ND	ND	ND	ND	85	ND
Naphthalene	ND	ND	ND	ND	ND	ND	120
Styrene	ND	ND	ND	ND	67	ND	ND
Tetrachloroethene	99	200	ND	ND	320	72	200
Toluene	24,000	20,000	200,000	350,000	110,000	40,000	3,100
Trans-1,2-dichloroethene	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	5.8	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	71	200	ND	ND	79	21	110
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	200
1,3,5-Trimethylbenzene	ND	ND	ND	ND	ND	ND	71
Vinyl chloride	53	ND	ND	ND	ND	13	ND
Xylenes (total)	3,400	9,500	23,000	ND	9,300	4,000	19,000

All results in ug/L (ppb)

J - Detected but below practical quantitation limit and above method
detection limit

ND - Not Detected

TABLE 4-7
HISTORICAL CHEMICAL ANALYSES OF GROUNDWATER SAMPLES
HCI - CHEMTECH - ST. LOUIS
MONITORING WELL MW2

Analyte	Date						
	4/92	3/94	12/94	12/95	9/96	5/97	1/98
Acetone	ND	ND	ND	ND	ND	880	9,800
Benzene	ND	1,400	1,800	ND	2,000	730	1,100
Chlorobenzene	18	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	2,400	ND	ND	ND	76	ND	ND
Cis-1,2-dichloroethene	ND	83,000D	ND	ND	ND	69,000	58,000
1,1-Dichloroethane	800	5,500	26,000	ND	ND	ND	4,600
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	310	300	ND	ND	ND	380	ND
Ethylbenzene	2,700	ND	ND	ND	210	110	ND
Methylene chloride	590	ND	ND	ND	ND	11	1,400
Methyl ethyl ketone	ND	ND	ND	ND	ND	ND	ND
Methyl isobutyl ketone	ND	ND	ND	ND	ND	210	ND
Styrene	ND	ND	ND	ND	22	ND	ND
Tetrachloroethene	770	ND	ND	ND	74	33	ND
Toluene	33,000	1,800	6,300	ND	4,500	2,200	9,800
Trans-1,2-dichloroethene	ND	2,900	4,400	ND	ND	ND	1,200
1,1,1-Trichloroethane	560	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	2,100	2,100	6,600	ND	2,600	2,400	3,500
1,2,4-Trimethylbenzene	ND	ND	ND	ND	130	ND	ND
Vinyl chloride	650	ND	ND	ND	190	200	ND
Xylenes (total)	20,000	400	ND	ND	1,270	580	2,200

All results in ug/L (ppb)

D - Compound identified in analysis at a secondary dilution factor

ND - Not Detected

TABLE 4-8

HISTORICAL CHEMICAL ANALYSES OF GROUNDWATER SAMPLES

HCI - CHEMTECH - ST. LOUIS

MONITORING WELL MW3

Analyte	Date						
	4/92	3/94	12/94	12/95	9/96	5/97	1/98
Acetone	NS	ND	ND	ND	ND	ND	ND
Benzene	NS	240,000D	23,000	39,000	9,700	17,000	1,000
Chlorobenzene	NS	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	NS	ND	ND	ND	1.5J	ND	ND
Cis-1,2-dichloroethene	NS	ND	ND	ND	8.8	120	ND
1,1-Dichloroethane	NS	ND	ND	ND	5.5	11	ND
1,2-Dichloroethane	NS	ND	690	ND	ND	ND	ND
1,1-Dichloroethene	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	100	ND	ND	49	63	12
Isopropylbenzene	NS	ND	ND	ND	ND	ND	7.4
Methylene chloride	NS	ND	ND	ND	ND	7.5	10
Methyl ethyl ketone	NS	ND	ND	ND	ND	ND	ND
Methyl isobutyl ketone	NS	ND	ND	ND	ND	ND	ND
n-Propylbenzene	NS	ND	ND	ND	ND	ND	12
Styrene	NS	ND	ND	ND	3.1J	ND	ND
Tetrachloroethene	NS	ND	ND	ND	ND	ND	ND
Toluene	NS	500	ND	ND	47	150	11
Trans-1,2-dichloroethene	NS	ND	ND	ND	ND	6.0	ND
1,1,1-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
Trichloroethene	NS	ND	ND	ND	3.4J	8.0	ND
1,2,4-Trimethylbenzene	NS	ND	ND	ND	150	ND	24
1,3,5-Trimethylbenzene	NS	ND	ND	ND	ND	ND	29
Vinyl chloride	NS	ND	ND	ND	ND	ND	ND
Xylenes (total)	NS	500	ND	ND	191	230	58

All results in ug/L (ppb)

D - Compound identified in analysis at a secondary dilution factor

J - Detected but below practical quantitation limit and above method
detection limit

ND - Not Detected

NS - Not Sampled

TABLE 4-9

HISTORICAL CHEMICAL ANALYSES OF GROUNDWATER SAMPLES

HCI - CHEMTECH - ST. LOUIS

MONITORING WELL MW4

Analyte	Date						
	4/92	3/94	12/94	12/95	9/96	5/97	1/98
Acetone	NS	ND	ND	ND	ND	ND	ND
Benzene	NS	300J	36	53	42	90	33
Chlorobenzene	NS	ND	ND	ND	ND	ND	ND
Chloroethane	NS	ND	ND	ND	ND	ND	11
1,2-Dichlorobenzene	NS	ND	ND	ND	2.7J	ND	ND
Cis-1,2-dichloroethene	NS	ND	ND	ND	30	16	10
1,1-Dichloroethane	NS	ND	110	32	20	7.6	5.6
1,2-Dichloroethane	NS	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	200J	34	33	37	62	15
Methylene chloride	NS	ND	ND	ND	ND	7.4	9.9
Methyl ethyl ketone	NS	ND	ND	ND	ND	ND	ND
Methyl isobutyl ketone	NS	ND	ND	ND	ND	ND	ND
Styrene	NS	ND	ND	ND	ND	ND	ND
Tetrachloroethene	NS	ND	ND	ND	ND	ND	25
Toluene	NS	2,700J	ND	29	190	270	31
Trans-1,2-dichloroethene	NS	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
Trichloroethene	NS	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	NS	ND	ND	ND	2.3J	ND	ND
Vinyl chloride	NS	ND	ND	ND	5.2J	ND	ND
Xylenes (total)	NS	1,100J	ND	27	22.8	200	28.7

All results in ug/L (ppb)

J - Detected but below practical quantitation limit and above method
detection limit

ND - Not Detected

NS - Not Sampled

TABLE 4-10

HISTORICAL CHEMICAL ANALYSES OF GROUNDWATER SAMPLES

HCI - CHEMTECH - ST. LOUIS

MONITORING WELL MW5

Analyte	Date						
	4/92	3/94	12/94	12/95	9/96	5/97	1/98
Acetone	NS	11,000	ND	ND	ND	ND	250
Benzene	NS	100	ND	ND	8.9	ND	9.8
Chlorobenzene	NS	ND	ND	ND	14	ND	5.2
1,2-Dichlorobenzene	NS	ND	ND	ND	ND	ND	22
Cis-1,2-dichloroethene	NS	500	ND	ND	25	880	520
1,1-Dichloroethane	NS	ND	120	ND	52	15	24
1,2-Dichloroethane	NS	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	NS	100	ND	ND	36	ND	25
Methylene chloride	NS	ND	ND	ND	ND	8.8	12
Methyl ethyl ketone	NS	600	ND	ND	ND	ND	ND
Methyl isobutyl ketone	NS	ND	ND	ND	ND	ND	ND
Naphthalene	NS	ND	ND	ND	ND	ND	7.9
Styrene	NS	ND	ND	ND	1.0J	ND	ND
Tetrachloroethene	NS	200	180	ND	3.8J	ND	7.4
Toluene	NS	3,300	46	4,300	140	ND	210
Trans-1,2-dichloroethene	NS	ND	ND	ND	1.7J	16	12
1,1,1-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	NS	ND	ND	ND	ND	ND	ND
Trichloroethene	NS	200	270	ND	2.4J	ND	11
1,2,4-Trimethylbenzene	NS	ND	ND	ND	61	ND	17
1,3,5-Trimethylbenzene	NS	ND	ND	ND	ND	ND	7.8
Vinyl chloride	NS	ND	ND	ND	24	280	200
Xylenes (total)	NS	1,000	ND	27	90	ND	139

All results in ug/L (ppb)

J - Detected but below practical quantitation limit and above method
detection limit

ND - Not Detected

NS - Not Sampled

TABLE 4-11
ANALYSIS OF RIVERBANK SEEP
September 4, 1998

Analyte	Result
Benzene	47
t-Butylbenzene	5.4
Chlorobenzene	84
1,2-Dichlorobenzene	48
1,1-Dichloroethane	40
cis-1,2-Dichloroethene	5.6
Ethylbenzene	200
Isopropylbenzene	20
p-Isopropyltoluene	5.4
Methyl ethyl ketone	150
4-Methyl-2-pentanone	25
Naphthalene	190J
n-Propylbenzene	38
Tetrachloroethene	31
Toluene	830
Trichloroethane	88
1,2,4-Trimethylbenzene	210J
1,3,5-Trimethylbenzene	130
Vinyl chloride	16
Xylenes (total)	950

All results in ug/L (ppb)

J- Detected, but below practical quantitation limit

TABLE 5-1

**PROPOSED ANALYSES FOR AREA OF
FORMER TANK FARMS 6 THROUGH 14**

Tank ID	Tank Farm	Former Tank Content	Chemical of Concern	Analysis
9	6	Caustic potash	Caustic	EPA 150.1
28	6	Caustic Soda	Caustic	EPA 150.1
3	7	Acetone/Methyl Ethyl Ketone	VOCs	EPA 8260
24	7	Methyl Iso Amyl Ketone	Ketones	EPA 8260
25	7	Methyl Iso Amyl Ketone	Ketones	EPA 8260
7	8	Toluene/Xylene	Toluene/Xylene	EPA 8020
26	8	Aromatic 100 (MS)	Benzene/Toluene/Xylenes	EPA 8020
29	8	Methanol	Methanol	EPA 8015
66	8	Blending Tank	Aromatics	EPA 8260
67	8	Blending Tank	Aromatics	EPA 8260
4	9	Reichold Mineral Spirits	TPH	EPA 8015E
15	10	Xylene	Xylenes	EPA 8060
22	10	Shell Sol 142 (MS)	Mineral Spirits	EPA 8015E
23	10	C-145 Flash	Mineral Spirits	EPA 8015E
16	11	Aromatic 200 (Mineral Spirits)	TPH, BTEX	EPA 8015E, EPA 8020
5	12	Reichold Mineral Spirits	TPH	EPA 8015E
8	13	Caustic Soda	pH	EPA 150.1
9	13	Caustic Potash	pH	EPA 150.1
6	13	Caustic Soda	pH	EPA 150.1
30	13	Caustic Soda (50%)	pH	EPA 150.1
27	14	Alkylate	pH	EPA 150.1

TABLE 5-2
PROPOSED ANALYSES OF BOREHOLE SOIL SAMPLES
HCI CHEMTECH ST. LOUIS FACILITY

Monitoring Well	Analysis				
	EPA 8260	EPA 8270	EPA 8015	Metals*	pH**
MW6	X	X	X	X	X
MW7	X	X	X	X	X
MW8	X	X	X		X
MW9	X				
MW10	X				X
MW11	X	X	X	X	
MW12	X				X
MW13	X	X	X	X	X

Up to three soil samples per borehole will be selected for analysis

*Only one sample from the selected boreholes will be analyzed for metals

** Only the shallow sample from each borehole will be analyzed

TABLE 6-1**MONITORING WELL LOCATION AND RATIONALE**

Monitoring Well	Location	Location Rationale
MW1	Central area of site, northeast of tank farm	Existing
MW2	Truck loading dock, next to tank farm	Existing
MW3	Adjacent to river	Existing
MW4	Central area of site, southeast of tank farm	Existing
MW5	Southeast area of truck loading, southwest of tank farm	Existing
MW6	Northeast corner of property	Monitor upgradient groundwater quality
MW7	Along western property boundary	Monitor upgradient groundwater quality
MW8	Site of reported former UST, in truck loading area	Evaluate any contaminants associated with the former UST and groundwater in the truck loading area in the upper part of the aquifer
MW9	Site of reported former UST, in truck loading area	Evaluate any contaminants associated with the former UST and ground water in the truck loading area in the lower part of the aquifer
MW10	Mid-area of site, north of new tank farm	Evaluate southern extent of contamination
MW11	Eastern half of site, south of tank farm	Evaluate contaminant concentrations in the upper part of the aquifer
MW12	Eastern half of site, south of old tank farm	Evaluate contaminant concentrations in the lower part of the aquifer
MW13	Southwest of maintenance building in eastern portion of site	Evaluate any contaminants associated with stormwater clarifier and southeast extent of contamination

TABLE 6-2

PROPOSED ANALYSES FOR GROUNDWATER MONITORING

HCI CHEMTECH ST. LOUIS FACILITY

Monitoring Well	Analysis				
	EPA 8260	EPA 8270	EPA 8015E	Metals	pH
HCI CHEMTECH					
MW1	X	X		X	X
MW2	X				
MW3	X	X		X	X
MW4	X				
MW5	X				X
MW6	X	X	X	X	X
MW7	X		X	X	X
MW8	X		X		
MW9	X				X
MW10	X				
MW11	X	X	X	X	X
MW12	X			X	X
MW13	X	X	X	X	x
USCG					
MW-4	X				
MW-5	X				
MW-6	X				
MW-9	X				

**DRAFT
REMEDIAL INVESTIGATION
AND REMOVAL ACTION WORKPLAN**

VOLUME II

QUALITY ASSURANCE PROJECT PLAN

**FOR
HCI CHEMTECH DISTRIBUTION
139 East Soper Street
St. Louis, Missouri 63111**

Prepared for:

**HCI-Chemtech Distribution
424 S. Woods Mill Road, Suite 325
Chesterfield, Missouri 63017**


Prepared by:

**C. Johnson Environmental
57 Amberwood Court
Moraga, California 94556**

June 1999

PROFESSIONAL CERTIFICATION

The Remedial Investigation and Interim Removal Action Workplan, the Quality Assurance Project Plan, the Sampling and Analysis Plan, the Standard Operating Procedures, and the Health and Safety Plan prepared for the HCI-Chemtech Distribution, Inc. site in St. Louis, Missouri were prepared under the direct supervision of Clarence Johnson, a Registered Geologist in the State of Missouri.


Clarence Johnson
R.G. 1006

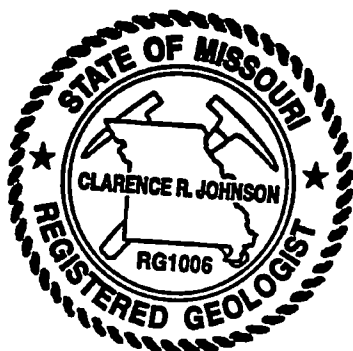


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- Appendix B Examples of Standard Laboratory and Sampling Audit Checklists
- Appendix C Data Validation Forms

Distribution List:

Mr. Bryant K. Burnett	U.S. EPA
Ms. Julie Warren	Missouri DNR
Mr. Jeff Simko	HCI USA Distribution Companies, Inc.
Mr. Blake Tucker	HCI-Chemtech Distribution, Inc.
Mr. Clarence Johnson	C. Johnson Environmental
Mr. Michael Sellens, RG	C. Johnson Environmental
Laboratory Manager	Environmetrics, Inc. (Subcontractor Laboratory)
Laboratory Manager	Air Toxics, Ltd. (Subcontractor Laboratory)

INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the organization, functions, procedures, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the data quality goals for the remedial investigation (RI) to be conducted at the HCI-Chemtech Distribution, Inc. (Chemtech) facility at 139 East Soper Street in St. Louis, Missouri (Soper Street). The procedures and specifications included in this plan apply to all RI activities conducted at the Soper Street facility. The QAPP establishes standard procedures and quality specifications for all aspects of the investigations conducted as part of the planned RI. The QAPP has been prepared by Chemtech and approved by the Missouri Department of Natural Resources (DNR) and the United States Environmental Protection Agency (EPA) which are collectively called the "Agencies." The following guidelines were used in the preparation of this QAPP:

- US EPA Draft Final Requirements for Quality Assurance Project Plans for Environmental Data Operations, October 1998 (EPA QA/R-5)
- US EPA Guidance for Quality Assurance Project Plans, February 1998 (EPA QA/G-5)
- US EPA Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (October 1988)

QAPP Objectives and Use

The goal of the procedures and specifications is to ensure that comparable data are produced by all parties associated with the RI, including laboratories, and that data quality is consistently assessed and documented. The specific objectives of the QAPP are to:

- Provide standardized references and quality specifications for all anticipated field, sampling, analysis, and data review procedures required for RI activities.
- Provide guidance and criteria for selecting field and analytical procedures.
- Establish QA procedures for reviewing and documenting compliance with the field analytical procedures.
- Establish procedures for communication among all RI participants, conflict resolution, and preparation of updates or additions to the QAPP.

The QAPP and the Sampling and Analysis Plan (SAP) are the two primary planning documents needed to conduct the RI; the QAPP is a reference for standard procedures and specifications, and the SAP details specific activities. The QAPP includes all current and anticipated procedures related to sampling surface water, ground water, soil, sediments, and air.

The QAPP presents the site-specific data quality objectives (DQOs) and sampling plans that identify sampling locations, numbers of samples, field procedures and analytical methods to be used. A Health and Safety Plan (HSP) is prepared for the RI, which is applicable to all further phases of the work, and establishes the safety procedures, level of personal protective equipment (PPE) required, and monitoring requirements and criteria.

The Chemtech document formats for the QAPP and SAP is based upon standard EPA guidance. A specific SAP has been developed for the RI. Using the standard QAPP procedures ensures comparable and consistent work throughout the facility, reduces redundancy in document preparation and review, and promotes efficient use of resources.

The QAPP is required reading for all staff participating in the RI, and the QAPP, SAP, and applicable Standard Operating Procedures (SOP) must be in the possession of field teams for all sampling efforts. Subcontractors are required to comply with procedures documented in this QAPP to ensure that comparable and representative data are produced.

Administrative Procedures

Because of the scope of the QAPP, standard procedures are needed to ensure good communication and consistent handling of administrative issues. To meet this goal the QAPP is categorized into four parts

Part A: Project Management

This part addresses the basic area of project management, including the project history and objectives, and roles and responsibilities of the participants.

Part B: Measurement/Data Acquisition

This part covers all aspects of measurement systems design and implementation, ensuring that appropriate methods for sampling, analysis, data handling, and QC are employed and are properly documented.

Part C: Assessment/Oversight

This part addresses the activities for assessing the effectiveness of the implementation of the project and associated QA/QC.

Part D: Data Validation and Usability

This part covers the QA activities that occur after the data collection phase of the project is completed.

QAPP Revision Procedures

Revisions or additions to the QAPP are needed when guidelines and regulatory documents are revised, or when additional sampling or analysis procedures are required. Determining when a revision is needed is a decision made cooperatively by the regulatory agencies and Chemtech. To ensure comparability of data produced by new or revised procedures and to make the most efficient use of resources, the following steps should be taken when a potential revision is identified:

- Review the current QAPP to determine whether an existing procedure will address the situation.
- If the current QAPP is insufficient, the Project Manager for Chemtech will notify all affected parties and prepare a brief summary and justification for the revision.
- Prepare the revised QAPP text and if needed, a revised SAP and SOP. The SAP and SOP should be identified as QAPP revisions and included as an attachment to the SAP. Agency review occurs as part of document review, and comments are addressed as needed.
- After approval, a copy of the final revisions of the documents shall be provided to all concerned parties.

Subcontractor review of a new procedure may be necessary or recommended before the procedure is incorporated into the QAPP. If so, a review should be arranged prior to agency review and issuing the working copy of the QAPP. All documents will be prepared following the standard format and guidance.

Conflict Resolution

Conflicts may arise between current and updated procedures when technical specifications are updated. Chemtech, with the assistance of the regulatory agencies and subcontractor, if deemed necessary, will identify and determine the most appropriate way to resolve any conflict. In all cases, the overriding consideration is to maintain data comparability and usability so that site decisions will not be wrongly influenced; alternately, any differences must be known so they may be incorporated into the decision-making process. Resolution may involve:

- Modification of contractual scopes of work to address non-compliance issues raised by using different procedures than initially specified, or to make language more flexible to accommodate changing conditions.
- Revision or additions to the QAPP.

- Requests for technical variances from the agency that issued the conflicting specification.

A. PROJECT MANAGEMENT

The following project management elements address the procedural aspects of project development and what to include in the QAPP project background, task description, and quality objectives elements

A1 Project Task/Organization

Chemtech has signed a consent order with the EPA and the DNR. Each party has a RI program manager (PM) who serves as spokesperson for his/her organization in directing the environmental work at the Chemtech St. Louis facility. The current project managers (PM), as of June 1999 are as follows:

U.S. EPA:	Mr. Bryant K. Burnett
Missouri DNR:	Ms. Julie Warren
HCI USA Distribution Company, Inc:	Mr. Jeff Simko
HCI Chemtech:	Mr. Blake Tucker
C. Johnson Environmental:	Mr. Clarence Johnson

The general project management organization for the Chemtech St. Louis facility RI is presented in Figure A-1. The PMs establish investigation or project objectives, scopes and schedules, and assign projects to internal staff and/or a supplier. The Chemtech project management team, is ultimately responsible for implementing the project and meeting the objectives. A detailed SAP referencing applicable procedures in this QAPP has been prepared; review and concurrence with the design and procedures are obtained from the regulatory agencies before implementing the plan. A SAP that specifies the activities, procedures, critical milestones, project team member responsibilities, and required resources is also developed. These objectives are defined in the Workplan and other supporting documents.

The overall program management responsibilities for the St. Louis facility will be handled by Chemtech and Chemtech's parent company HCI USA Distribution Company, Inc., (HCI). HCI and Chemtech will be accountable for all aspects of the site investigation and remediation, procedures for all program activities, and the establishment of program milestones.

Implementation of the RI at the site is directed and funded by the HCI and Chemtech. C. Johnson Environmental (CJE) will be the primary consultant throughout the project. The RI and any further remedial work and management will be supervised by HCI, Chemtech, and CJE, and will be assisted by a number of material suppliers, subcontractors, and consultants throughout the project.

All subcontractors involved in the RI will be coordinated by CJE. These services may include technical services such as analytical chemistry, drilling services, remedial equipment suppliers, and other technical, engineering, and consulting services.

Chemtech and CJE are responsible for the contractual aspects of project work that includes ensuring appropriate staff are assigned and allocating adequate field equipment and other resources. They ensure that technical activities have appropriate planning and oversight to fulfill technical project requirements, and provide high quality and timely data and reports. The following list identifies key program personnel and their areas of responsibility.

- | | | |
|----|--------------------------------|--|
| A. | Sampling Operations: | Michael Sellens RG, CJE |
| B. | Field and Sampling QA: | Michael Sellens RG, CJE |
| C. | Laboratory Analysis QA and QC: | Environmetrics Laboratory Manager
Air Toxics Laboratory Manager |
| D. | Data Quality Review: | Clarence Johnson RG, CJE |
| E. | Project and Overall QA/QC: | Clarence Johnson RG, CJE
Jeff Simko, HCI |
| F. | Project Coordination: | Clarence Johnson, CJE |

A2 Problem Definition/Background

Subsurface investigations at the site have identified halogenated and aromatic hydrocarbons in the underlying soil and ground water. There are also a number of areas at the facility where, due to past operations, there is the potential of environmental impairment. Presented below is a general description of the site, its operations, and activities conducted to date to characterize the identified contamination at the site. A more detailed description is presented in the RI Workplan.

A2.1 Site Description

The Chemtech St. Louis site is located at 139 East Soper Street, St. Louis, Missouri 63111 (see Figure A-2). HCI purchased the site from Chemtech Industries, Inc. (CII) in 1992. The site covered 6.2 acres and included 83 above ground storage tanks, with a total capacity of approximately 7,900,000 gallons. Other structures at the site include a 4,700 foot square office, a 32,900 square foot warehouse, and a 5,700 square foot maintenance shop. In 1995, HCI - Chemtech acquired the adjacent property to the south of the original St. Louis facility from St. Louis Steel Castings, Inc. (Steel Castings). The area of the acquired site was 8.69 acres. All of the buildings on the Steel Castings site were removed from the site prior to the purchase by Chemtech. Since the time of the purchase of the Steel Castings site, two new tank farms with improved secondary containment have been constructed. Several tanks from the original tank farms have been relocated to these new tank farms. A site plan for the current Chemtech site is shown in Figure A-3.

The warehouse includes space for storage of drums, a maintenance area, a solvent drum filling area, an acid drum filling room, an acid and caustic drum rinsing room, a "white room" for handling pharmaceutical and food grade chemicals, and an 8,500 gallon blend tank in the solvent drum filling room. Matlack Trucking leases the maintenance shop office on the east side of the property. A small laboratory building is located across Broadway Avenue approximately 500 feet from the facility.

A2.2 Environmental Setting

The Chemtech site is located in an industrial area adjacent to the Mississippi River. Broadway Avenue, which runs parallel to the river approximately 200 feet north of the facility, separates the industrial area from residential areas to the northwest. A Coast Guard station is immediately adjacent to the site to the northeast. A metal recycler, Southern Metal, is to the northwest of the facility. To the east and southeast is the Mississippi River and the facility barge dock. To the southwest is Lone Star Cement Company, a cement mixing and distribution facility, and Rhone-Poulenc Agricultural Company, an agricultural chemical mixing and storage facility. The closest residences are approximately 1,000 feet to the northwest of the facility. There are no schools, hospitals, or sensitive environments reported to be near the site.

The site is underlain by sand and silty sand, much of which is imported fill. Discontinuous layers of slag from the historical metal casting operations in the area, a few inches thick, are found at 10 to 16 feet below the ground surface across the facility.

At normal river stage, the site is approximately 25 to 30 feet above the level of the river. Groundwater elevation is controlled by the river elevation. At normal river stage, ground water is found between 20 and 25 feet below the ground surface. Groundwater flow is normally towards the river, however, during periods when the river is rising, a temporary reversal of the direction of flow may occur. There are no known beneficial uses of the ground water near the site, and there are no water supply wells which could be impacted by any releases of chemicals.

A2.3 Ownership History

The first two occupants of the site, Mississippi Valley Iron Company and Armstrong Foundry and Manufacturing produced cast metal products. The next tenants, Frontier Chemical Products, Inc. and St. Louis Solvents and Chemical Company were chemical distributors. CII acquired the property in 1967 and began expanding the capacity of the tank farms as operations were moved from other sites to the Soper Street location. HCI acquired the facility from CII in 1992 and renamed the company HCI - Chemtech Distribution, Inc. In 1995, Chemtech acquired the adjacent property to the south of the original facility from Steel Casting.

A2.4 Facility Operations

The Chemtech St. Louis facility receives bulk liquid chemicals in barges, rail cars, and trucks. These chemicals are transferred to bulk storage tanks. Dry chemicals and packaged

liquid chemicals are received by truck. From the bulk storage tanks, chemicals are delivered to customers in bulk or are transferred to 55-gallon drums for shipment to customers. Each tank is individually plumbed to the truck loading areas and the solvent filling areas to minimize the need for line flushing. Chemicals may also be blended prior to delivery in bulk, or prior to being transferred to drums. Blending operations are conducted in Tanks 61 and 65 in Tank Farm 5, in 4,000 and 1,000 gallon tanks in the warehouse, and in a 1,100 gallon tank in the white room. All chemical transfer operations take place in areas with spill containment, including concrete catch basins and drip pans to catch minor amounts of solvents during hose disconnection. All hoses are blown to ensure that no chemicals are left in the hose which could spill when the hose is disconnected from the pump. All drums are sent off site for reclaiming or recycling, except acid and caustic drums which are rinsed at the facility.

The total throughput of chemicals for 1997 is estimated to be 13,500,000 gallons of liquid chemicals and 600,000 pounds of dry chemicals. Of this total, 12,000,000 gallons of the liquid chemicals are received and stored in bulk, and 1,500,000 gallons are received in containers with capacities of 55 gallons or less. All of the dry chemicals are received in packages, no dry chemicals are handled in bulk. Caustics account for approximately 1,650,000 gallons of the liquid chemicals. Acids account for 650,000 gallons of the liquid chemicals. The remaining liquid chemicals are organic products including aromatic solvents, ketones, alcohols, surfactants, heat transfer fluids, aliphatic solvents, glycols, and acetates. Caustics, toluene, and xylenes arrive primarily by barge. All other chemicals are received by both tank car and truck.

Although Chemtech operated its own truck fleet in the past, the trucking operations are currently contracted to Matlack Trucking Inc. (Matlack). At this time, Chemtech owns only a few yard tractors for shuttling trailers on the property. Matlack is responsible for the maintenance of the vehicles, and storage and disposal of any wastes generated by the maintenance of the vehicles.

At the time Chemtech was acquired by HCI, the site had 83 above ground storage tanks. The number of tanks at the facility reached a high of 92 in 1988. Currently, there are 76 tanks at the site with a total capacity of 7,728,629 gallons. At the time of the acquisition in 1992, the tanks were located in containment areas with concrete walls and dirt floors.

Incompatible chemicals were separated by the walls between the tank farms. The dirt floors would not have been completely effective in completely containing releases in the tank farms.

Although the property was leased and not owned for two years after the purchase, the tank farms used for storage of alcohols, aliphatic solvents, and some of the aromatic solvents were paved with concrete to improve the secondary containment shortly after the company was purchased. After title to the property transferred to HCI and the purchase of the Steel Castings site was completed in 1996, a new tank farm was constructed with concrete walls and floors for barge tanks. At this time only the floors of tank farms 1, 2, 4, 6, and 13 are unpaved. Tank Farms 3, 4, 6, and 13 are used for storage of caustics. There are seven tanks with a total

capacity of 2,340,000 gallons. Tank Farms 1 and 2 have 23 tanks with a total capacity of 207,129 gallons. Only nine of these tanks, with a total capacity of 77,245 gallons, are currently in use. Glycol, alcohol, acetate, surfactant, and acid are stored in these tanks. The tanks in Tank Farms 1 and 2 are progressively being removed from service.

Inventory control is achieved through surveying of barges prior to unloading, weighing trucks in and out, weighing drums as they are being filled, and gauging rail cars and storage tanks. Tank inventory is reconciled either weekly, biweekly, or monthly. The schedule is dependent on the environmental hazard posed by the chemical. The inventories of the tanks containing the chemicals with the greatest environmental hazard are reconciled weekly. All tanks are visually inspected every day. There are no underground storage tanks or underground lines at the facility.

A2.5 Previous Studies

The focus of this section is the data generated by previous studies at the Chemtech St. Louis site. A summary of this information is presented below.

Pilko Phase I Report for St. Louis Site

Pilko and Associates, Inc. (Pilko) prepared a Phase I report titled "Environmental Risk Assessment of Chemtech Industries, Inc., St. Louis Distribution Branch" for CII. The report is dated August 1988. This report includes a description of the facility, a description of the operations, the waste management practices, water management practices, a search for evidence of waste disposal onsite, spill containment and contingency planning, an evaluation of air emissions, and evaluation of the potential for the presence of polychlorinated biphenyls (PCBs) and asbestos.

There were no soil or groundwater samples collected for chemical analysis as part of this study. However, the report references a study conducted by Geotechnology, Inc. (Geotechnology) in 1984. This apparently refers to a letter included in the appendix to the Pilko report from Geotechnology to Chemtech dated July 18, 1985 and an internal Chemtech memo dated June 19, 1985. The results of the chemical analyses of soil samples are provided, however, it is impossible to determine precisely the locations and depths at which the soil samples were because no site map is provided. According to the memo, the highest contamination occurred near the dock, the truck loading bay, the solvent tank farm, and the rail unloading station. The chemicals which were found and the range of concentrations were: acetone, 0.17 to 0.3 parts per million (ppm); methyl ethyl ketone (MEK), 13.0 ppm; toluene, 2.5 ppm to 1,100 ppm; xylenes, 0.018 to 640 ppm; methylene chloride, 0.046 to 21 ppm; and TOX (no further definition given), less than 0.01 ppm to 0.19 ppm. Soil pH ranged from 4.5 to 11.2.

ESE Limited Phase I Audit

Environmental Science and Engineering, Inc. (ESE) prepared a report titled: "Limited Phase I Environmental Audit, Chemtech Industries, Inc., St. Louis Missouri Distribution Branch." The report is dated September 1991. The purpose of the report was to update the environmental assessment prepared by Pilko in 1988. The ESE report includes a description of the facility and the operations at the site, a description of the waste streams and environmental permits, an environmental violations record search, a summary of spills and releases, and conclusions and recommendations. No soil or groundwater sampling was conducted as part of the assessment.

CJE Environmental Assessment

In May 1992, C. Johnson Environmental (CJE) conducted a Phase I and Phase II pre-acquisition site assessment of the St. Louis facility. The report includes a review of the environmental data available at that time, a description of the physical setting of the plant, the operations at the plant, a description of the chemical and waste management, and drilling of three boreholes and installation of monitoring wells in two of the borings to sample the soil and ground water at the site. The location of the borehole (VSB) and the two monitoring wells (MW1 and MW2) are shown in Figure A-3.

For the investigation of the soil and groundwater contamination, one monitoring well (MW2) was installed near the truck loading area downgradient from the solvent tank farm (Tank Farm 5). Some solvents, notably xylene, toluene, and mineral spirits are also stored in the barge tanks, which are larger and located closer to the barge dock. The second monitoring well (MW1) was installed near the hazardous waste storage area and the barge tanks. The third borehole (VSB) was drilled near the edge of the river.

One soil sample was collected from each of the three boreholes in the most contaminated zone as determined by headspace analysis of split spoon samples. A groundwater sample was collected from each of the monitoring wells. The samples were analyzed for volatile organic compounds using EPA Methods 8010 and 8020.

The analyses of the soil and ground water show that the site is contaminated with aromatic and chlorinated solvents. The solvents are present in higher concentrations in the soil near the tank farms and truck loading area than by the river in the soil samples. The aromatic solvents present in the soil samples in the highest concentrations are toluene and xylenes at maximum concentrations of 200 ppm and 56 ppm, respectively. Trichloroethene and 1,2-dichlorobenzene are the chlorinated solvents found in the highest concentrations in soil samples at 6.5 ppm and 3.6 ppm, respectively.

The groundwater samples from MW2, which is near the solvent tank farm, has higher concentrations of all solvents except for benzene and chlorobenzene than MW1, which is downgradient of MW2. Toluene (33,000 parts per billion [ppb]) and xylenes (20,000 ppb) are

the aromatic compounds present in the highest concentrations, and 1,2-dichlorobenzene (2,400 ppb) and trichloroethene (2,100 ppb) are the highest chlorinated solvents.

To evaluate the potential for the casting slag used as fill at the site to impact the environment, two samples were submitted for analysis using the Toxicity Characteristic Leaching Procedure (TCLP). No metals were detected in the leachate from the sample collected from MW1. Only mercury at a concentration of 1.6 ppb was found in the sample from VSB. This is below the hazardous waste standard of 200 ppb.

EDP Environmental Assessment at the USCG Facility

The USCG has a facility immediately to the north of Chemtech. In 1992, the USCG commissioned an environmental assessment of their facility. EDP Consultants, Inc., produced an interim report to document the results of their Phase I survey, and a final report which contained the results of their Phase I and Phase II surveys. The Phase I report described the facility, the environmental and geographical setting, the operations conducted at the facility, and recommended that a Phase II assessment be conducted.

The Phase II assessment included the drilling of 17 boreholes to collect soil samples and installing monitoring wells (see Figure 2-2 in the Workplan) in nine of the boreholes. Samples were collected for analysis for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, total recoverable petroleum hydrocarbons, and pH.

The conclusions in the report were that there was no threat of environmental impairment as a result of the presence of any chemicals in the soil. The report also concluded that there was no threat of environmental impairment from the presence of metals or semivolatile organic compounds in the ground water. No conclusion was expressed concerning the results of the analyses for total recoverable petroleum hydrocarbons. The report concluded that the VOCs exceeded the action levels established by the DNR. Acetone, 2-butanone, cis-1,2-dichloroethene, ethylbenzene, toluene, vinyl chloride, and xylenes were all found in the ground water in concentrations greater than 1,000 ppb. The report also concluded that the source of these compounds is the Chemtech facility to the south of the USCG facility.

CJE Site Investigation

As a result of the investigation at the USCG site, DNR requested that Chemtech undertake a site investigation to further define the contamination. The results of that investigation are given in the site investigation report by CJE dated June 30, 1997. The site investigation included drilling three boreholes, collecting soil samples from the boreholes, installing monitoring wells (MW3, MW4, and MW5) in the boreholes, and collecting groundwater samples from the three new monitoring wells and the two existing wells on site. The samples were analyzed for VOCs using EPA Method 624/8240, alcohols by EPA Method 8015 (modified), RCRA metals by acid extraction and atomic absorption, and base/neutral extractable SVOC by EPA Method 8270.

The results show that the VOCs are present in the soil in concentrations less than 1.0 ppm with the exceptions of toluene (1.4 ppm) and xylenes (2.0 ppm). SVOCs were all less than 0.64 ppm with the exceptions of 2-methylnaphthalene (1.5 ppm) and bis(2-ethylhexyl)phthalate (2.3 ppm). Of the RCRA metals, arsenic (71 ppm) and lead (160 ppm) were present in elevated concentrations. No alcohols were present in the soil.

Of the 33 positive results for SVOCs in groundwater, 28 were present in concentrations less than 74 ppb, and five were between 74 ppb and 690 ppb. Of the VOCs, benzene was found in the highest concentration (240,000 ppb). Toluene (20,000 ppb), xylenes (9.5 ppb), cis-1,2-dichloroethene (90,000 ppb), and 1,1-dichloroethane (6.9 ppb) were also present in high concentrations. Barium (870 ppb), arsenic (280 ppb) and mercury (0.5 ppb) were reported in the ground water. Lead was not detected in the ground water. No alcohols were present in the ground water.

Continued Site Monitoring

Since the completion of the site assessment in 1994, groundwater samples have been collected periodically from the five groundwater monitoring wells on the St. Louis site. The results of the monitoring are inconsistent. Part of this may be due to the use of more than one laboratory and the very high concentrations of toluene in samples collected in December of 1994 and 1995. However, overall the results show a downward trend in the concentrations of chemicals in groundwater.

Release of Caustic Soda from Tank 28

In 1996, a leak was discovered in the bottom of Tank 28. It was determined that 23,000 gallons of caustic soda had been released to the soil under the tank. The DNR agreed to the proposal to repair the tank and put the tank back into service. The DNR also required that a remediation plan be submitted.

To determine the need for remediation, a worst case scenario was developed to estimate the effect of the caustic on the Mississippi river. The calculations determined that the worst case concentration of caustic soda to the river through the ground water would be between 3.8 ppm and 0.38 ppm at the soil/river water interface. Given the mixing which would occur in the river, the concentration would drop below 0.008 ppm rapidly. Therefore, natural attenuation was proposed as the remediation method. The DNR has not required any additional action since that time.

Toluene Samples Under Tank 7

During the course of moving Tank 7 to a new tank farm, signs of a release were noted in the soil under the tank. Samples were collected at depths of 1.0 feet, 3.5 feet, and 5.0 feet for analysis for toluene and xylenes, the products stored in Tank 7. The results of the analyses were: toluene and xylenes at 27 ppm and 273 ppm, respectively, at 1.0 feet; toluene, less than 1.0 ppm,

and xylenes, 59 ppm at 3.5 feet; and both toluene and xylenes at less than 1.0 ppm at 5.0 feet. Based on the results of the analyses of soil samples, no further action was deemed to be necessary.

Phase I and Phase II Audits of the St. Louis Steel Casting Site

In February 1991, ESE prepared a Phase I and limited Phase II environmental audit of the Steel Casting site. The report included a description of the facility, the operations at the site, and a limited facility history. Field work included an asbestos survey, a PCB survey, and analyses of soil samples for waste oil, priority pollutants, and TCLP metals, and radiation measurements.

The ESE report states that the facility manufactured high and low alloy carbon steel and stainless steel castings from 1934 to 1986. The steel was melted in electric arc or electric induction furnaces and poured into molds. Potential sources of contamination include the metals brought onto the property, asbestos, oils, paints, and PCBs from the transformers on site.

Steel Casting Remediation

Prior to sale of the Steel Casting site to Chemtech, the owner was required to remove all structures from the site and conduct remediation to the satisfaction of DNR. Environmental Operations, Inc. (EO) was retained by the owner to conduct a site investigation to define all areas for which remediation might be required. Six areas were found which required remediation: the main transformer area (PCBs), the furnace area, the TH3/4 area (SVOCs and pesticides), the scrap metal storage area (metals and total petroleum hydrocarbons), the capacitor spill area (PCBs), and the river transformer area (PCBs). A revised remediation plan was submitted to DNR on April 11, 1995. The report was review and approved by Mr. Timothy Chibnall of DNR.

The remediation consisted of excavating contaminated soils and collecting clearance samples to demonstrate that all of the contaminated material had been removed. Excavation began in May 1995 and was completed in June 1995. A report was submitted to DNR which contained a description of the work performed and the results of the analyses of clearance samples. DNR approved the remediation in June 1995.

A3 Project/Task Description and Schedule

The work proposed at Chemtech's St. Louis facility includes further site characterization. The RI is being conducted to complete the site characterization which was started under earlier programs. The goals of the RI are to:

1. define the margins of significant contamination;
2. define the concentrations of chemicals in the soil and ground water;

3. define all source areas;
4. characterize the stratigraphy; and
5. determine if a risk assessment is necessary.

To obtain this information it is proposed to drill boreholes for the collection of soil samples for laboratory analysis and to better define soil stratigraphy; install additional groundwater monitoring wells; conduct groundwater monitoring and sampling, and collect and analyze surface soil and groundwater samples.

The schedule for implementation of the RI will be determined at the time that final approval for the Workplan and the other associated documents, i.e. QAPP, is given by the EPA and DNR. Development of the schedule is dependent on the time required for approval and the weather conditions at the time approval is granted. The expected schedule is given in Section 10.0 in the RI Workplan.

A4 Quality Objectives and Criteria for Measurement Data

Data quality objectives (DQOs) and quality assurance objectives (QAOs) are related data quality planning and evaluation tools for all sampling and analysis activities. A consistent and comprehensive approach for developing and using these tools is necessary to ensure the data produced fully characterize the site. The DQOs for the project are presented in Appendix A.

A5 Special Training Requirements/Certification

All aspects of the RI will be performed by qualified and experienced personnel. Personnel training will be the responsibility of each retained contractor. Contractors will be required to certify that all of their employees are qualified to conduct the work assigned. Any changes in personnel must be approved by Chemtech or their representative. In addition to job training, all personnel involved in the RI will need to have completed suitable health and safety training appropriate to their involvement in the project. It will be the responsibility of the contractor to provide the relevant training.

In addition to formal training, all personnel entering areas where chemical exposure may occur will be required to attend a facility safety orientation. This orientation will advise all outside contractors of the operations of the facility, the chemicals to which they may be exposed, and associated specific safety issues at the facility.

All certifications, i.e. technical training, health and safety, are the responsibility of the retained subcontractors. The RI will be overseen by a Registered Geologist in the State of Missouri.

A6 Documentation and Records

All data collected, including field notes, borehole logs, raw data, and laboratory reports with chain-of-custody records will be collected and filed. A formal report will be prepared to summarize the findings, conclusions, and recommendations, and will be submitted to all concerned parties.

A6.1 Collected Records and Information

The nature of the data collected and reported will be dependent on how the data is to be used. A summary of the records to be maintained for the RI are outlined below.

Field Operation Records: Field notes and records will be maintained throughout the duration of the project associated with the following:

Sample Collection Records: Records will include all field notes, well development and purging tables, borehole logs, and field maps of sampling locations. All field notes will be collected in site-specific bound notebooks or on pre-printed forms.

Chain-of-Custody Records: Records documenting the handling and transportation of all soil, water, and vapor sediments collected will be kept and maintained from the original collection location to the laboratory.

Quality Control Records: As prescribed in the SAP and the RI Workplan, field, trip, equipment rinsate, and duplicate samples will be collected for laboratory analysis. In addition, records related to sample integrity and preservation will be maintained on the chain-of-custody record and the laboratory report. Calibration information related to field screening instruments will also be maintained, if applicable.

Laboratory Records: The contractor laboratory will report and maintain records associated with the following:

Sample Data: Any laboratory used to analyze soil, sediment, water, or vapor samples will be required to maintain records that report the date and time the analyses were conducted, verify that holding times are maintained, specify the number of samples received and analyzed, and report any deviations from the SOP or original directives from Chemtech.

Sample Management Records: The laboratory shall maintain the chain-of custody record, and note any anomalies, i.e. damaged samples. The laboratory shall also be responsible for documenting any problems with sample preservation or holding time requirements.

Analytical Test Methods: Analyses are to be conducted in accordance with the methods requested. Any variation from the prescribed methodology will be documented.

QA/QC Reports: All laboratory reports will included, as a minimum, the general QC records, such as initial demonstrations of capability, instrument calibration, routine monitoring of analytical performance, and calibration verification. Project-specific information from the QA/QC checks such as blanks (field, reagent, rinsate, and method), spikes (matrix, matrix spikes, analysis matrix spike, and surrogate spike), calibration checks samples (zero checks, span checks, and mid-range checks), replicates, and splits will also be included, when applicable.

Data Handling Records: All records associated with data reduction, verification, and validation, will be available to the EPA and DNR. This will include all raw data.

A6.2 Data Reporting Package Format and Documentation Control

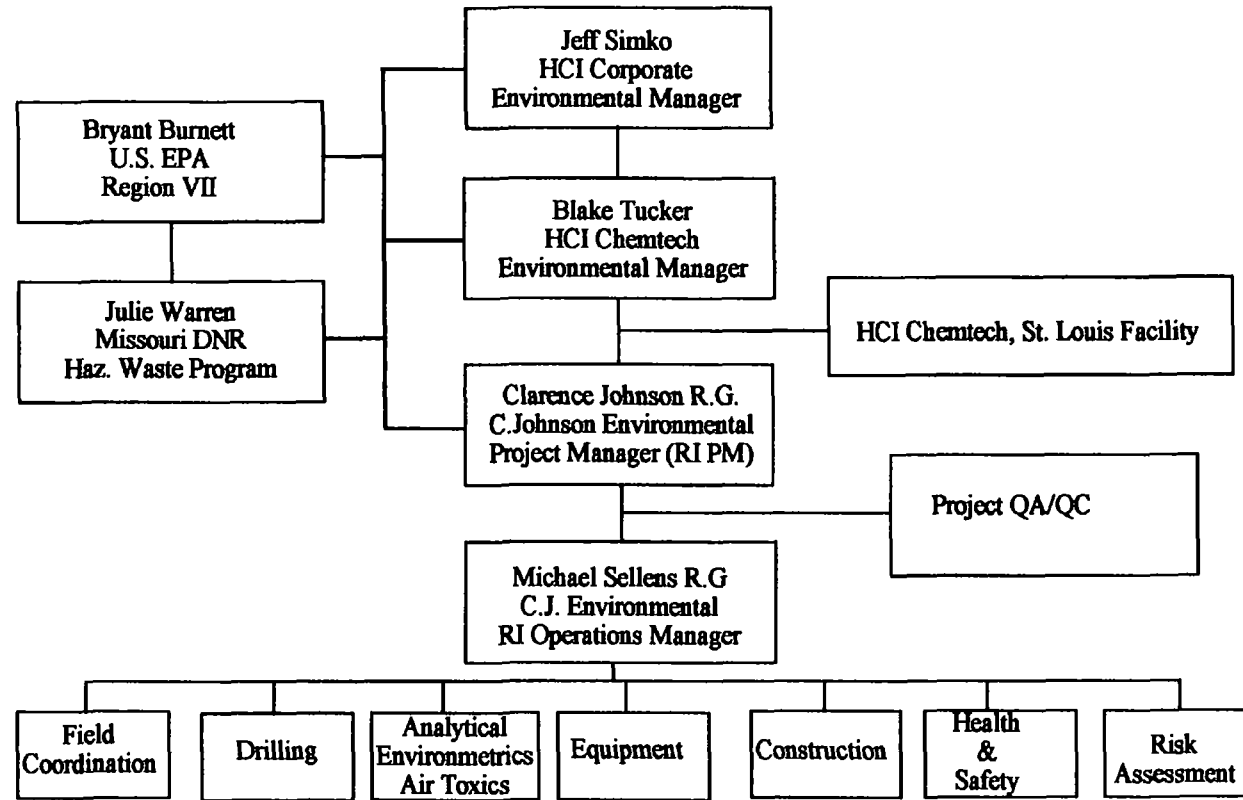
All reports and data will be available as hard copies, unless a different format is required by the party being supplied or requesting the data. Chemtech will supervise and control the distribution of documents and information. Each report will initially be issued as a "Draft" for review by all PMs and their selected contractors, if applicable. Comments will be provided to the HCI PM, within 45 days of the "Draft" submittal. Comments will be addressed in letter form by Chemtech, HCI, and their representative, within 30 days of receipt. If no comments are received within 30 days of the submittal of the comment response, the responses will be incorporated into the document, where applicable, and the document will be issued as a "Final." Extensions to the review and response periods are to be coordinated through the HCI PM. The named PMs will be supplied with two copies of each prepared document. Other parties will be supplied with necessary documents on an as-needed basis, as determined by Chemtech and the regulatory agencies.

A6.3 Data Reporting Package Archiving and Retrieval

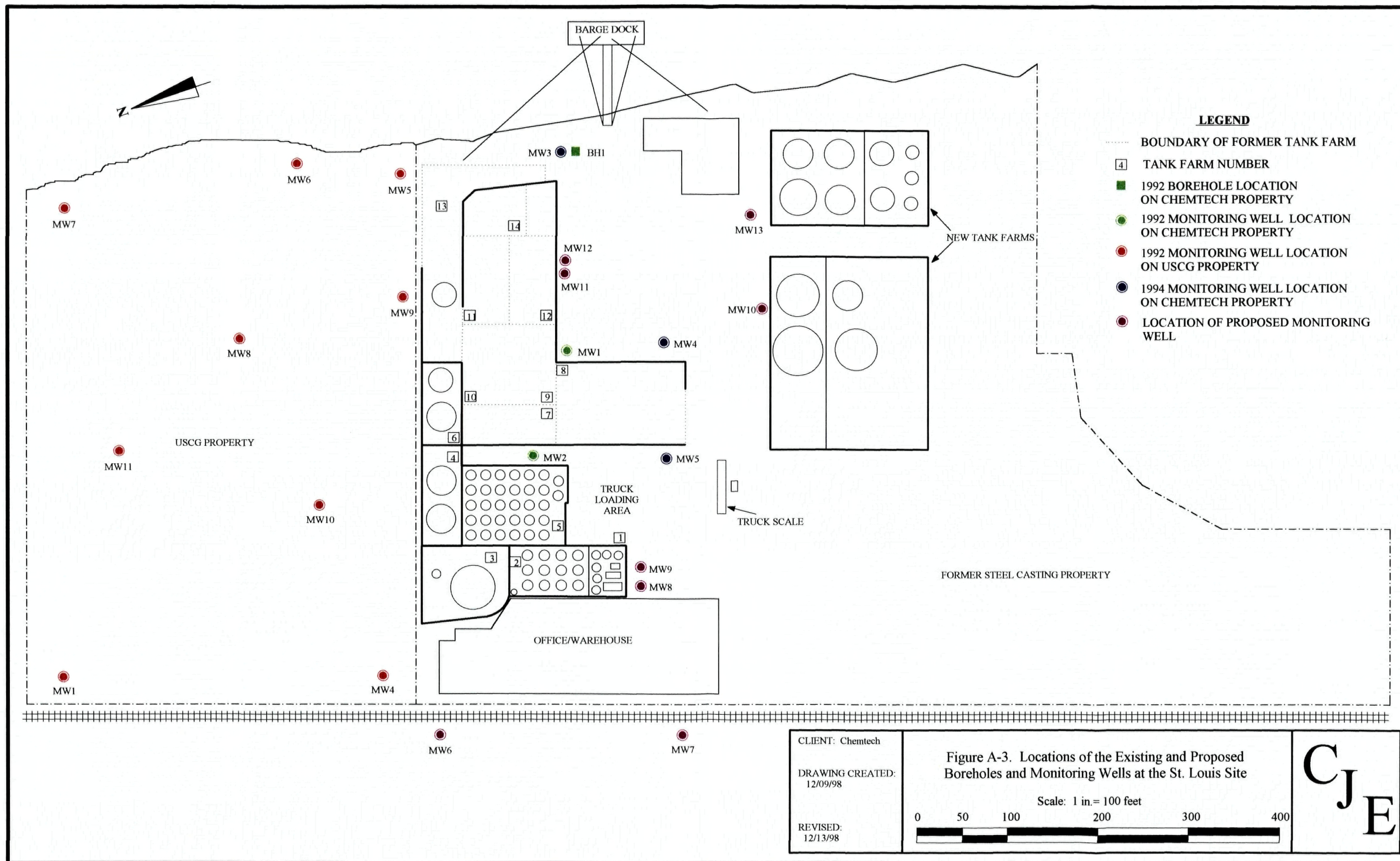
Chemtech, HCI, EPA, and DNR will each be responsible for custody of documents submitted to or generated by each party. A master copy of all documents will be maintained by Chemtech at their Corporate office in St. Louis, Missouri. Copies of all documents are to be maintained for the duration of the project, and a minimum of 180 days following the completion of the project. After that time, documents can be destroyed at the discretion of the owner. Persons requiring additional copies of any document or data package, are required to make a formal request, in writing, for the data through the HCI PM.

Figure A-1

HCI - Chemtech St. Louis RI Organization Chart




$$C_J E$$



B. MEASUREMENT/DATA ACQUISITION

This section of the QAPP covers all aspects of measuring systems design and implementation, thus ensuring that appropriate methodologies are used for sampling, analysis, data handling, and quality control. The proposed work at the Chemtech St. Louis facility consists of: the drilling of boreholes for the collection of soil samples; sediment sampling; surface water sampling; installation and sampling of groundwater monitoring wells; ambient air sampling; and laboratory analysis.

B1 Sampling Process Design

The purpose of this section of the QAPP is to describe all the relevant experimental or data collection designs required for the planned remedial investigation (RI). Sampling conducted as part of this project will be site specific.

B1.1 Investigation Areas

Based upon an understanding of the site historical activities and the results of previous investigations, there are six areas associated with the facility where further assessment and investigations are required. These areas are:

1. tank farms 6 through 14;
2. the former diesel fuel underground storage tank;
3. the stormwater clarifier;
4. surface river water (Mississippi River);
5. near-shore river sediments; and
6. riverbank seeps.

B1.2 Site/Activity Clearances

Before field activities begin, a underground utility survey will be conducted using facility personnel, site plans, and public services to obtain clearances for each boring or sampling location. Field activities will be coordinated with facility personnel as not to disrupt normal business activities.

B1.3 Soil Sampling Locations

To obtain adequate information to complete the soil investigation at the facility and to obtain a fuller understanding of the stratigraphy underlying the site, soil sampling will be

conducted at various locations throughout the site where chemical storage and transfer activities have been or are currently conducted.

B1.3.1 Tank Farms 6 through 14

In 1997, 18 of the 19 storage tanks that had been in Tank Farms 6 through 14 were removed and relocated to two new tank farms in the southern portion of the original St. Louis facility. A single tank remains in Tank Farm 13. The old tank farms were constructed with earthen floors and cement walls for secondary containment. With the exception of a release of caustic soda from Tank 28 in 1996, and a toluene/xylene release from Tank 7 observed during the removal of the tank, no releases of concern are known to have occurred in this area. However, to evaluate the former tanks as potential sources of contamination, shallow soil sampling will be conducted in the area of the removed tanks.

Using historical records and information obtained from facility employees, a soil sample will be collected at the site of the transfer valve of each of the former tank sites and the remaining tank in Tank Farm 13. Each sample will be collected from a depth of approximately three feet below ground surface (bgs). If field screening, i.e. headspace analysis, indicates contamination is present, a deeper sample may be collected for analysis. Details on the soil sampling program are given in Sections 5.1.1 and 5.2 of the RI Workplan.

B1.3.2 Underground Storage Tank

A diesel fuel underground storage tank (UST) was present in the area south of Tank Farm 1, adjacent to the facility office. The UST was taken out of service and filled with concrete in 1985. In 1990, the UST was removed from the ground. However, no records or sampling results associated with its removal have been located. To determine if any environmental impairment associated with the UST is present and further assess any site wide contamination, one borehole will be drilled to assess soil stratigraphy and subsurface contamination. Complete details of the soil sampling program are presented in Sections 5.1.2 and 5.2 of the RI Workplan.

B1.3.3 Stormwater Clarifier

A stormwater clarifier is located in the area south of the facility's maintenance building, on the east side of the property. To determine if any environmental impairment is present that is associated with the clarifier and assess any contamination along the southern boundary of the original St. Louis property, one borehole will be drilled in this area to assess soil stratigraphy and evaluate any subsurface contamination. Details of the soil sampling are given in Sections 5.1.3 and 5.2 of the RI Workplan.

B1.4 Sediment Sampling

To evaluate the potential of contaminants migrating off the site and accumulating in the sediments of the Mississippi River, river sediment samples will be collected. Sampling locations

will be determined in the field based upon river accessibility and safety, but will include locations upstream and downstream of the St. Louis facility. Details of the sediment sampling are given in Section 5.3 of the RI Workplan.

B1.5 Groundwater Sampling

There are currently five groundwater monitoring wells at the facility. Since their installation in 1992, groundwater monitoring has been conducted, during which volatile and semi-volatile organic compounds have been reported. Although semi-volatile organic compounds (SVOC) have only been reported at low levels, volatile organic compounds (VOC) have been identified at levels of concern. The compounds of particular concern have been benzene, toluene, xylenes, cis-1,2-dichloroethene, trichloroethene (TCE), and tetrachloroethene (TCE).

To further assess site-wide groundwater quality, a total of eight new groundwater monitoring wells will be installed at the facility. This will include monitoring wells at the former UST and stormwater clarifier locations, plus six additional locations. The monitoring wells will be installed using hollow stem auger drilling. Following the installation of the new monitoring wells, all wells at the site will be surveyed to a common datum point and groundwater samples will be collected for analysis following suitable well development and purging. The results of the well sampling will be used to develop a facility-wide groundwater monitoring program. Details on the locations, sampling, and analyses for the groundwater monitoring wells are given in Sections 6.2 and 6.3 of the RI Workplan.

B1.6 Surface Water Sampling

Chemtech will conduct surface water sampling associated with seeps along the river bank and from the Mississippi River.

B1.6.1 River Bank Seep Sampling

During periods of low river levels, contaminated water has been observed seeping from the river bank at the adjacent US Coast Guard (USCG) facility. A current daily inspection program on the Chemtech St. Louis facility has not observed any seeps. To evaluate the nature of the seep contamination, Chemtech will seek the assistance of the USCG to allow sampling of the seep water and determine if any man-made structures are causing any preferential flow. Chemtech will also continue the daily inspections of the river bank at the St. Louis facility. Details regarding the proposed sampling and analysis of any seeps is presented in Section 6.4 of the RI Workplan.

B1.6.2 River Water Sampling

To determine that the contaminated soil and groundwater identified at the St. Louis facility is not impacting the quality of the water in the Mississippi River, samples of river water will be collected for analysis. Three samples will be collected, with the sampling locations being

determined in the field based upon river accessibility and safety, but will include locations: upstream of the USCG facility; adjacent to the St. Louis facility; and downstream of the St. Louis facility. Additional details regarding the proposed sampling and analysis of river water is presented in Sections 5.3 and 6.4 of the RI Workplan.

B1.7 Ambient Air Sampling

To determine if air emissions which could present an environmental concern are leaving the site, air samples will be collected from upwind and downwind locations. Details on the selection of the sampling and analytical methods are given in Section 7.2 of the RI Workplan.

B2 Sampling Method Requirements

This section includes descriptions of field procedures that will be used to conduct the remedial investigation (RI) at Chemtech's St. Louis facility. Detailed equipment and procedure descriptions are included in the standard operating procedures (SOPs).

B2.1 Sample Collection, Preparation, and Decontamination Procedures

As part of the RI, soil, sediment, and surface and groundwater samples will be collected. In addition, air samples will be collected to monitor ambient air quality.

B2.1.1 Soil Samples From Boreholes

Soil samples will be collected during the RI to evaluate soil contamination and characterize the stratigraphy. Detailed descriptions of each step in the drilling activities are presented in SOP-004. Drilling operations for hollow stem auger drilling techniques are described in SOP-009

Soil samples obtained utilizing hollow-stem auger drilling will be collected with a split-spoon sampler driven by a drive hammer. The technique is described in SOP-016, Soil Sampling. Samples collected with split-spoon samplers, along with drill cuttings will be logged by the rig geologist using the logging protocol provided in SOP-004 for Drilling Operations.

Either stainless-steel or brass liners will be used in the split spoon to isolate and maintain sample integrity when chemical or physical testing is required. The liners (sleeve sections) selected for analysis are capped with Teflon sheeting or aluminum foil and PVC endcaps. The liners are then labeled, placed in a plastic bag, and shipped to the laboratory. A representative portion of the sample is always retained for field description on a lithology log.

The split-spoon sampler and the liners will be decontaminated according to the procedures provided in the SOP-004 for Drilling Operations. For sampling unconsolidated and uncemented sands or gravel deposits, a split-spoon sampler equipped with a sample catcher may be used to minimize sample loss.

B2.1.2 Sediment Samples

Sediment samples will be collected from near-shore locations in the Mississippi River. Sediment samples can be collected using either a scoop or dredge. Each technique allows for the collection of discrete samples. The actual sampling technique will be dependant on sampling location field conditions and the depth of the water. Based on expected field conditions, samples will be collected using a dredge, see SOP-015, Collection of Surface Soils/Sediment Samples in Ponds, Surface Impoundments, and Streambeds. Following sample collection, the sample is placed in a clean, laboratory supplied glass jar with a teflon-lined lid, and treated as described in the method for split spoon sampling.

B2.1.3 Groundwater Samples

During the RI activities, groundwater samples will be collected from all the monitoring wells at the St. Louis facility. Details regarding the monitoring well groundwater sampling activities are described in Groundwater Sampling SOP-013.

Prior to the collection of any groundwater samples from a monitoring well, each well will be purged and monitoring parameters measured to evaluate purging completeness. Water levels are measured at the beginning of each sampling activity and immediately before samples are collected. Purging will be conducted using either a dedicated bailer or a controllable low-flow submersible pump. Purging completeness is monitored by measuring pH, specific conductance, and temperature during purging; and ensuring that these parameters are stable before groundwater samples are collected. Monitoring of dissolved oxygen concentration and turbidity may also be used as a sensitive indicator of groundwater stability during purging. Stability is assumed when:

- pH measurements vary less than 0.1 pH unit;
- Conductance measurements vary less than 5 percent; and
- Temperature measurements vary less than 1.0 degree Celsius.

After these measurements have stabilized, and a minimum of three wetted casing volumes of water have been purged, groundwater samples can be collected. Special conditions that are exceptions to this protocol may occur and are addressed as follows:

- If the monitoring parameters do not stabilize, samples can be collected after six wetted casing volumes have been purged.
- If the well is purged dry before three wetted casing volumes have been removed, samples can be collected as soon as the well recovers to 80 percent of the original volume of water.
- At least three sets of monitoring parameter measurements must have been taken.

B2.1.4 Surface Water Samples

Surface water samples will be collected from the Mississippi River and seeps occurring along the river. Samples will be collected directly into the sample container. In the river, downstream locations are sampled first, upstream locations are sampled last. This minimizes the potential for cross-contamination, carryover from sampling equipment, or disturbed sediments influencing downstream samples. Surface water samples are always collected prior to any sediment samples. The sampling procedures are presented in Surface Water Sampling SOP-032.

B2.1.5 Air Samples

Ambient air samples will be collected as part of the project scope. Samples are collected in laboratory cleaned and supplied evacuated canisters, and hence no decontamination or pre-sampling purging is required. Sampling procedure and protocols are outlined in SOP-017.

B2.2 QA/QC Samples

Quality Assurance (QA) and Quality Control (QC) samples will be collected and analyzed to validate the quality of the RI collected data. One duplicate sample will be collected at a frequency of 10 percent of all samples collected. In addition, one trip blank and one field blank will be analyzed for each shipment to the laboratory, and one equipment blank will be analyzed for each day of sample collection.

B2.3 Decontamination Procedures

All field and sampling equipment that may come in contact with samples must be decontaminated after each use. All decontamination liquids (water, solids) will be collected in appropriate containers and are contained and disposed of as appropriate after the results of the analyses have been obtained. All wastes will be stored and transported in approved containers only.

All drilling and sampling equipment will arrive at the facility clean. Between drilling and sampling locations, equipment will be decontaminated if deemed necessary, using steam cleaning or high-pressure hot water until visibly clean. This may include the back portion of the drill rig, other large support equipment, auger flights, pipes, cables, and rods.

Downhole and surface sampling equipment including split spoon samplers, sampling sleeves, groundwater sampling hoses, and hand augers will be decontaminated between uses by the following procedures:

1. Scrub with water and laboratory-grade phosphate-free detergent (e.g., Alconox) to loosen any dirt or oily material (hose is not scrubbed).

2. Clean using a steam cleaner or high-pressure hot water until all visible traces of material have been removed.
3. Rinse with potable and deionized (DI) water.
4. If applicable, rinse with reagent-grade methanol and hexane or cyclohexane if any residue remains.
5. Rinse again with DI water after solvents have dried to remove any residue
6. All decontaminated equipment will be stored and transported in clean, decontaminated containers.

Water level meters, submersible pumps, non-disposable bailers and other equipment that contacts samples are decontaminated in a similar manner.

B2.4 Cuttings and Groundwater Disposal

Cuttings and other waste produced during drilling are addressed in the SOP for Drilling Operations (SOP-004). Chemtech is responsible for management of all investigation-derived wastes.

During drilling operations, cuttings will be monitored for organic vapors and will be contained in 55-gallon steel drums. Monitoring will be performed when the drums are at half capacity and when filled. A copy of the completed drum label will be placed in a plastic bag and placed on top of the drum contents. The containers will be sealed and marked with the well or boring number, site name, and date. After well or borehole completion, all well and borehole cuttings will be removed to a specified holding area at the facility. Proper management and disposal of cuttings will be determined after subsequent sampling and analysis of the collected samples.

Groundwater produced during drilling will be collected in leak-proof metal drums or tanks. Based upon analytical results, the water will be discharged to either the local sanitary sewer system or transported to a licensed disposal facility. The timing and transportation of groundwater produced during drilling activities will be coordinated with the facility management.

Nonhazardous trash will be disposed of in the facility dumpsters for municipal landfilling. Trash suspected to be hazardous will be placed in 55-gallon drums for disposal at a licensed facility.

B3 Sample Handling and Custody Requirements

Sample containers are purchased pre-cleaned and treated according to EPA specifications. Sampling containers that are reused will be decontaminated between uses by the procedure

outlined in section B2.3 of this QAPP. Cleaned containers are stored separately to prevent exposure to fuels, solvents, and other chemicals. Tables B-1 and B-2 list sample storage and preservation requirements for each method and matrix.

A standard sample identification scheme has been developed to ensure consistent and unique sample numbers (SampID) for all sampling locations. The proposed SampID protocol is outlined in Section 5.0 of the SAP.

All data collected in the field will be documented on either a borehole log sheet or in a bound field notebook.

All samples will be stored at four degrees Celsius (C) immediately after collection until analysis. In the field, samples will be stored in ice chests and kept cool with ice. The chain-of-custody record will accompany sealed sample containers to the laboratory. Chain-of-custody records documenting possession and transportation of all soil, sediments, water, and vapor collected will be kept and maintained from the original collection location to the laboratory. An example of a Chain-of-Custody record is included as Figure B-1.

B4 Analytical Method Requirements

All soil, sediment, and water samples will be analyzed or managed by Environmetrics, Inc., of St. Louis, Missouri. Air samples will be analyzed by Air Toxics Ltd., of Folsom, California. Both laboratories will conduct all analyses in accordance with standard EPA procedures and QA/QC protocols.

The primary contaminants at the Chemtech facility consist of aromatic and halogenated VOCs. In addition, local concerns related to petroleum hydrocarbons, SVOCs, and pH will be evaluated. Based upon this criteria laboratory analyses of soil and groundwater samples will be limited to VOCs by EPA Method 8260; extractable hydrocarbons by EPA Method 8015E; SVOCs by EPA Method 8270; and pH by EPA Method 150.1. Air samples will be analyzed by Method TO-14, with acetone included in the analytical schedule.

B4.1 EPA Method 8260, Volatile Organic Compounds

Volatile organics in water and soil samples may be analyzed using EPA Methods 8260. The methods consist of a purge-and-trap gas chromatography/mass spectrometry (GC/MS) technique. Method 5030 is used to remove the VOCs from the sample matrix onto an adsorbent trap. The trap is backflushed and heated to desorb the purgeable organics onto a GC, where the organics are separated and subsequently detected with a mass spectrometer. The method analytes and quantitation limits (QLs) for these methods are listed in Tables B-3.

B4.2 EPA Method 8015E, Extractable Hydrocarbons

Extractable petroleum hydrocarbon (TPH) components, mineral spirits, oils, and heavier molecular weight petroleum products will be analyzed using EPA Method 8015, using GC analysis with a flame ionization detector (FID), following extraction by Method SW3550.

Extraction Method SW3550 is a procedure that uses a sonication process for extracting nonvolatile organic compounds from soils and sediments, with the sample mixed with anhydrous sodium sulfate, then dispersed into the solvent using sonication. The extract is gravity or pressure filtered and concentrated. The resulting solution may be diluted or analyzed directly using the appropriate technique. Methylene chloride is typically used as the solvent, although other solvents may be used for specific analytical applications.

Identification and quantitation of extractable hydrocarbons is based on pattern recognition techniques. Selected components are used to calibrate the instruments, and the resulting patterns and carbon ranges are used to compare the sample results. These components are usually reported when they match the identified calibrated patterns. Often, unknown/uncalibrated hydrocarbons are encountered and are reported as such on the laboratory report.

B4.3 EPA Method 8270, Semivolatile Organic Compounds

SVOC, also known as base/neutral and acid extractables (BNA), in water and soil are analyzed using EPA Method 8270. Organic compounds are extracted from the sample with methylene chloride at pH greater than 12 to obtain base/neutral extractables. Acid extractable compounds are obtained by a second extraction with methylene chloride after the pH has been adjusted to two or less. Both base/neutral and acid extracts are then concentrated by removing methylene chloride through evaporation. Compounds of interest are separated and quantified using a GC/MS. The method analytes and QLs for Method 8270 are presented in Table B-4.

B4.4 EPA Method 150.1/SW9045, pH

Field and laboratory pH measurements may be taken for water samples; the pH of soil samples is measured in the laboratory. All measurements are determined electrometrically using either a glass electrode combined with a reference potential or a combination electrode. The meters are calibrated daily using the manufacturer's guidelines and at least two buffer solutions and standard QC acceptance criteria (± 0.05 pH units).

B4.5 Method TO-14 GC/MS Analysis of Air

The canister method follows the guidelines established in the EPA's Compendium of Methods for the Determination of Toxic Compounds in Ambient Air (1984). Air or soil gas samples are collected in evacuated stainless steel canisters for analysis by GC/MS. The TICs will be compared to a NIST library of mass spectra. A fit factor will be reported with each TIC to assess the accuracy of analyte identification in the sample.

After a sample is received from the field and logged into the laboratory system, the canister pressure and temperature are measured and logged into a separate sample analysis notebook and then measured and recorded. Nitrogen is added to the canisters to provide positive pressure for removing the sample, to dilute oxygen and moisture in the sample, and to minimize sample component reactions. Quantitation limits for Method TO-14 are listed in Table B-5.

B5 Quality Control Requirements

Both field and laboratory QC samples will be collected and analyzed as part of the RI project.

B5.1 Field QC Samples

Field QC samples are used to assess the influence of sampling procedures, equipment, and handling on the reported results. They are also used to characterize matrix heterogeneity. Details regarding the field QC elements are presented below.

B5.1.1 Field Duplicate Samples

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate sample results are used to assess total precision and variability associated with the laboratory analysis and the sample collection process. Duplicate samples are collected simultaneously or sequentially using identical recovery techniques and are treated identically during transportation and analysis. Duplicate samples will be collected at a frequency of approximately 10 percent of all samples collected.

B5.1.2 Field Blanks

Field blanks for water sampling are laboratory supplied organic-free water exposed to ambient conditions and then collected and processed using the same procedures as other samples. Field blanks are used to assess the potential for contaminant introduction from ambient sources, and are collected only for VOC analyses. These blanks are collected by pouring organic-free water from a storage container or vial prepared in an uncontaminated environment into a sample container at the designated location or by opening the sample container at the sampling location for the duration of sample collection. Field blanks are collected at sites that represent an area or site and/or are downwind of potential VOC sources such as active runways, engine test cells, or busy roadways. One field blank will be submitted for analysis with every shipment of samples to the laboratory.

B5.1.3 Equipment Blanks

Equipment blanks use deionized water that is used in the decontamination of field sampling equipment. The water is poured through a decontaminated sampling device, collected in the sample container, and transported to the laboratory for analysis. Equipment blanks are

recommended for equipment that has been decontaminated after sampling a known contaminated well or site, and periodically throughout the sampling effort. One equipment blank will be prepared for each day of sampling.

B5.1.4 Trip Blanks

A trip blank is a sample of organic-free water (prepared as for ambient blanks) placed in the sample container in an uncontaminated laboratory area prior to field work. Trip blanks are prepared only for VOC samples and are handled the same as field samples. Trip blank results are used to identify contamination from sample containers or transportation and storage procedures. One trip blank will accompany each shipment of samples being transported to the laboratory for VOC analysis.

B5.2 Laboratory QC/QA Samples

Laboratory quality elements will be conducted in accordance with EPA and normal laboratory procedures and protocols. Details regarding the laboratory QC elements are presented below.

B5.2.1 Method Spike

Method spikes are blank (reagent water or ultrapure nitrogen) spikes containing analytes of interest at a specified concentration, usually in the mid-calibration range. Sometimes a method spike duplicate is also prepared and analyzed. The method spike duplicate undergoes the entire sample preparation and analysis process and can demonstrate that the method/instrument is stable and operating within acceptable accuracy and precision limits. It also monitors consistency in sample preparation procedures. Laboratory control samples are required for all laboratory analytical methods at a frequency of one per analytical batch or one per 20 field samples, whichever is more frequent.

B5.2.2 Method Blank

A method or reagent blank (MB) is a sample composed of all the reagents in the same quantities used to prepare a sample for analysis. The MB undergoes the same sample preparation procedure as a sample. Method blanks ensure that interferences from the analytical system, reagents, and glassware are under control. The required frequency for analyzing method blanks is one per day for each method/instrument and/or one per preparation analytical batch (up to 20 samples). For gas phase analyses, MBs commonly are composed of a sample of ultrapure nitrogen gas carried through the entire analytical scheme. The blank is from the same nitrogen source used to dilute the samples. A method blank analysis is performed for each analytical batch and immediately after analysis of any sample containing high concentrations of analytes.

B5.2.3 Matrix Spikes/Matrix Spike Duplicates

A matrix spike (MS) is a solution of known concentrations of selected target analytes spiked into a field sample before sample preparation and analysis. An additional aliquot of the sample is spiked for the matrix spike duplicate (MSD) analysis. The analytical results of the duplicate spiked samples are used to identify matrix interferences that influence the recovery or measurement of method analytes. MS/MSD frequency is one per preparation and analytical batch (up to 20 samples). A Chemtech St. Louis sample must be used for the MS/MSD.

B5.2.4 Surrogate Spikes

Surrogate spikes are analytes that do not occur naturally but behave similarly to the target analytes selected for each organic analytical method. A surrogate analyte solution of known concentration is spiked into each sample, standard, blank, and QC sample prior to sample preparation and analysis. The recovery of the surrogate spike compounds is reported for each sample, and the results are compared to the recovery objectives established for the method. Surrogate spike results provide a measure of instrument and method performance and indicate sample-specific matrix effects.

B5.2.5 Laboratory Duplicates

Laboratory duplicates are repeated, but they are independent analyses of the same sample, by the same analyst, at essentially the same time and under the same conditions. The sample is split in the laboratory, and each fraction is carried through all stages of sample preparation and analysis. Duplicate analyses are used to assess the precision of each analytical method. Laboratory duplicates are performed for a limited number of methods, generally those for which spiked duplicate samples cannot be performed. Laboratory duplicates provide limited or no information if all or most analytes are not detected in the sample selected for duplication. If performed, the required frequency is one laboratory duplicate per analytical batch (up to 20 samples).

B6 Instrument/Equipment Testing, Inspection, and Calibration

To complete the RI both field and laboratory equipment will be used. A summary of activities associated with the equipment is presented below.

B6.1 Field Instruments

Several types of real-time instruments are used to monitor and evaluate the physical parameters of water and soil. This portable gas analysis equipment is also used to monitor worker health and safety and to assist sample collection. Field instruments used for the Chemtech St. Louis RI program will include:

Groundwater parameters measuring instruments:

pH meter,
conductivity meter, and
thermometer;

Organic vapor monitoring instruments:

photoionization detectors (PID) in organic vapor meters (OVM); and canister
sample flow controllers.

To ensure that the instruments are operating properly and are producing accurate and reliable data, routine calibration must be performed prior to and during use. Factory calibrations should be performed at a frequency recommended by the manufacturer.

Field calibrations (if applicable) should be performed at least once per day, prior to instrument use. If field calibration reveals that the instrument is outside established accuracy limits, the instrument should be serviced in the field, or if necessary, return the instrument to the manufacturer for immediate repair and servicing.

B6.1.1 Water Sampling Instruments

Field pH and conductivity meters and thermometers are used to measure water parameters when collecting groundwater samples. The pH and conductivity meters are calibrated with at least two standard calibration solutions, supplied by the manufacturer, that bracket the expected range of measurements. Thermometers are calibrated on a routine basis using a National Institute of Standards and Technology (NIST) reference thermometer. SOP-024 describes the calibration procedures and operation of these instruments.

B6.1.2 Organic Vapor Monitoring Instruments

Real-time OVMS are routinely used to monitor total airborne organic vapors during field operations; measurements are used to evaluate worker health and safety. Personal protective equipment (PPE) requirements and site control decisions are based upon the results of real-time measurements. These instruments also provide screening level data for VOC concentrations in drill cuttings, soil boring samples, and groundwater wells. For the proposed project at the St. Louis facility an OVM with a PID will be used.

A PID can measure total organic vapors and are highly sensitive to aromatic compounds, moderately sensitive to unsaturated chlorinated compounds, and less sensitive to aliphatic hydrocarbons. The instrument can respond to organic compounds with ionization potentials (IPs) less than the rated electron voltage (eV) of the ultraviolet (UV) bulb in the unit. Due to its longevity and range of detectable contaminants, the PID used for Chemtech St. Louis RI will be a Thermo Environmental 580B OVM with a 10.2 eV UV bulb installed. Detailed procedures for calibration and operation of an OVM instrument is presented in SOP-020.

B6.1.3 Canister Flow Controller

Adjustable flow controllers will be used to control the fill rate of Summa canisters during air sampling. As required in the *Compendium of Methods for the Determination of Toxic Compounds in Ambient Air* (EPA 600/4-84-041, April 1984), flow controllers must be calibrated prior to each use to ensure a constant fill rate throughout the prescribed sampling period. Flow controller calibration will be performed as specified in the operation manual which comes with the flow controller provided by the analytical laboratory.

B7 Instrument Calibration Frequency

Instrument calibration will be conducted at the frequency specified in the manufacturer's operation manual. Details regarding instrument calibration are presented in Section B6.

B8 Inspection/Acceptance Requirements for Supplies and Consumables

All supplies and consumables used throughout the RI will be standard industry supply, and hence no special requirements are needed beyond that presented in the applicable SOP.

B9 Data Acquisition Requirements

The data obtained during the RI will be used to determine when further action may be required. This may include further site assessment or remedial action. The need for further action will be based on the information obtained from the data search and consultation with the DNR and the EPA.

B10 Data Management

The management of laboratory data will be in accordance with the laboratory standard operating procedure and standard industry and EPA protocols and requirements.

B10.1 Laboratory Data Reduction and Verification

Data reduction, verification, and reporting procedures are important segments of data management to ensure that accurate and consistent data handling, review, and reporting are achieved. Each laboratory is responsible for the reduction of raw data generated at the laboratory bench to calculate sample concentrations. For most methods, data reduction software is included in the instrument. In those cases, the analyst must verify that the data reduction was correct. The system may require manual manipulation to correctly calculate sample concentrations. The analytical process includes verification or a QC review of the data. This includes:

- Verifying the calibration or calibration check sample for compliance with laboratory and project criteria.

- Verifying that batch QC samples were analyzed at the proper frequency and that the results were within specifications.
- Comparing raw data with the reported concentrations for accuracy and consistency.
- Verifying that the holding times are met and that reporting units and quantitation limits are correct.
- Determining whether corrective action (reanalysis of QC or project samples, reextraction and reanalysis) is needed and, if so, is performed and documented.
- Verifying that all project and QC sample results were properly reported and flagged.
- Preparing narratives that identify and discuss any problems encountered.

The QC checks are performed by laboratory supervisors, and other qualified staff. After the data have been reviewed and verified, the laboratory reports are signed and released for distribution. Raw data and supporting documentation are stored by the laboratory.

B10.2 Project Data Flow, Transfer, and Verification

Laboratory and field data must flow properly to the project staff and data users, following adequate QC review. Analytical data will come from the subcontracting laboratories as hard paper copies, in a standard format. The analytical data will be combined with field measurements and lithologic data, if necessary, for reporting purposes.

B10.3 Project Data Review and Validation

Designated staff from the laboratory, C. Johnson Environmental, and HCI will perform data review and validation for the activity, as required. Project data review includes, at a minimum:

- Chain-of-custody review.
- Holding time compliance evaluation.
- Adequate batch QC frequency for all data.
- Review of all QC sample results for compliance with project objectives.
- Qualification of sample results influenced by QC sample results.

B10.4 Reporting

Throughout the duration of the project, various reports will be prepared to document the results, interpretations, and scopes for further activities. The following procedures are to be employed to ensure general reporting quality for interpretive reports:

- Technical peer review for technical accuracy, clarity, and organization.
- All calculations and measurements will be verified by the person who initially provided the data, after which they will be independently reviewed and verified

by another individual. Any calculations and measurements that differ from the initial results will be resolved by both individuals. Calculations and measurements included in an internal working copy will be re-checked during peer review.

- Numerical values presented in reports and comparisons of numbers appearing in text, tables, and appendices will be addressed in the manner discussed above.
- Technical editors will check all reports for proper format, grammatical correctness, and correct references to figures, tables, sections, or appendices.

General reporting practices for measurement data include:

- Headings that uniquely identify samples and the analytical method.
- Consistent units of measure.
- Consistent number of significant figures.
- No blank or dashed places reported; all spaces contain a designation.
- Comparison with regulatory standards or other established values if applicable;
- Use of footnotes to designate special conditions or exceptions.

Measurement data generated during an investigation will be reported in tabular form to support data use and interpretation. The report formats vary depending on the information being presented, however, in general, data will be presented according to sampling location, analytical method, parameter, and/or matrix.

Custom table formats are to be used to support interpretation of the investigative data. The format depends on how the results are expected to be used, such as all samples collected from a site, for a particular analytical method, or other designated subset.

Typically, QC will not be incorporated in any tabular form, unless deemed important in the interpretation of the data. However, all QC data is to be included in any laboratory data package, and may be included as an appendix in any report.

CHAIN-OF-CUSTODY RECORD

Project # :		Client: HCI Chemtech				# of Containers	Type of Containers	TYPES OF ANALYSIS												Turn Around Time: Normal : <input type="checkbox"/> Rush : <input type="checkbox"/>	
		Project: Soper Street, St. Louis, MO						VOCs (EPA 8260) SVOCs (EPA 8270) TPH-E (EPA8015E) PH(EPA156.1/9045)											Verbal Due _____ Report Due _____		
Sampler(s) _____ <small>(Signature)</small>		_____																			
Sample ID	Date	Time	Matrix	Comp	Station Location														Remarks		
Relinquished by:			Date/Time	Received by:		Date/Time	Report To:														
Relinquished by:			Date/Time	Received by:		Date/Time	Copies To:														
Relinquished by:			Date/Time	Received by Laboratory:		Date/Time	Send Invoice To:														

Figure B1: Chain-of-Custody Form

Table B-1

Sample Storage and Preservation Requirements : Soil and Groundwater Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Extractable Hydrocarbons	EPA8015E	14-days	1x1liter Amber Bottle Sleeve or 8oz jar	None	4 degrees C
Purgeable Organics	EPA8260	14 days	3x40ml Glass Vials Sleeve or 8oz jar	pH <2, with HCL	4 degrees C
Base/Neutral and Acid Extractables	EPA 8270	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottle Sleeve or 8oz jar	None	4 degrees C
pH	EPA 150.1/SW9045	Field Test (w) ASAP (s)	500ml Poly Bottle 250ml Glass Jar	None	4 degrees C

Table B-2

Sample Storage and Preservation Requirements : Air Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Total Non-Methane Hydrocarbons	TO12	14 days	Summa Canister	None	None
Volatile Organic Compounds	TO14	14-days	Summa Canister	None	None

Table B-3

Quantitation Limits For EPA Method 8260, Volatile Organics Compounds

Method	Parameter	Analytes	Maximum Quantitation Limits		STARC "C" (mg/kg)	C Leach (mg/kg)	GTARC (ug/L)	MCL (ug/L)
			Soil (mg/kg)	Water (ug/L)				
8260	Volatile organics compounds	Acetone	0.1	50	8660	14	4000	Not Est.
		Benzene	0.005	1	227	0.057	5	5
		Bromodichloroethene	0.005	1	Not Est.	Not Est.	Not Est.	100
		Bromoform	0.01	1	320	1.6	100	100
		Bromomethane	0.01	5	Not Est.	Not Est.	Not Est.	Not Est.
		2-Butanone	0.1	100	Not Est.	Not Est.	Not Est.	Not Est.
		Carbon disulfide	0.005	5	21	52	4	Not Est.
		Carbon tetrachloride	0.005	5	6.6	0.3	5	5
		Chlorobenzene	0.01	1	109	2.2	100	100
		Chloroethane	0.01	5	Not Est.	Not Est.	Not Est.	Not Est.
		2-Chloroethylvinylether	0.01	10	Not Est.	Not Est.	Not Est.	Not Est.
		Chloroform	0.01	5	5.8	0.864	100	100
		Chloromethane	0.1	2	Not Est.	Not Est.	Not Est.	Not Est.
		Dibromochloromethane	0.005	2	Not Est.	Not Est.	Not Est.	Not Est.
		1,1-Dichloroethane	0.005	2	Not Est.	Not Est.	Not Est.	Not Est.
		1,2-Dichloroethane	0.005	2	5.6	0.024	5	5
		1,1-Dichloroethene	0.005	2	0.2	0.1	7	7
		trans 1,2-Dichloroethene	0.005	2	1820	1.13	100	100
		1,2-Dichloropropane	0.005	2	21	0.047	5	5
		1,3-Dichloropropene	0.005	2	1.9	0.017	2	Not Est.
		Ethylbenzene	0.005	2	1460	55	320	700
		2-Hexanone	0.05	10	Not Est.	Not Est.	Not Est.	Not Est.
		Methylene chloride	0.025	5	145	0.021	5	5
		4-Methyl-2-pentanone	0.05	50	Not Est.	Not Est.	Not Est.	Not Est.
		Styrene	0.01	2	2120	13.5	100	100
		Tetrachlorethene	0.005	2	160	0.42	5	5
		1,1,2,2-Tetrachloroethane	0.005	2	6	0.012	0.4	Not Est.
		Toluene	0.005	2	890	5.13	150	1000
		1,1,1-Trichloroethane	0.005	2	1520	4.67	200	200
		1,1,2-Trichloroethane	0.005	2	14	0.049	5	5
		Trichloroethene	0.005	2	81	0.097	5	5
		Vinyl acetate	0.05	5	Not Est.	Not Est.	Not Est.	Not Est.
		Vinyl chloride	0.01	5	0.54	0.016	2	2
		Xylenes	0.01	2	1510	55	320	10000

STARC "C" : Missouri Clean-Up Level for Soils, Scenario "C"

C Leach : Missouri Clean-Up Level for Soils, Leaching to Groundwater Pathway Scenarios

GTARC : Missouri Clean-Up Level for Groundwater

MCL : US EPA Maximum Contaminant Limit

Table B-4

**Quantitation Limits For EPA Method 8270
Semi-Volatile Organic Compounds**

Method	Parameter	Analytes	Maximum Quantitation Limits		MCL (ug/L)
			Soil (mg/kg)	Water (ug/L)	
8270	Base/ Neutral SVOCs	Acenaphthene	0.35	10	Not Est.
		Acenaphthylene	0.35	10	Not Est.
		Anthracene	0.35	10	Not Est.
		Benzo(a)anthracene	0.35	10	0.1
		Benzo(b)fluoranthene	0.8	10	0.2
		Benzo(k)fluoranthene	0.8	10	Not Est.
		Benzo(ghi)perylene	0.35	10	Not Est.
		Benzo(a)pyrene	0.35	10	0.2
		Benzyl alcohol	0.35	10	Not Est.
		bis(2-Chloroethoxy)methane	0.4	10	Not Est.
		bis(2-Chloroethyl)ether	0.4	10	Not Est.
		bis(2-Chloroisopropyl)ether	0.4	10	Not Est.
		bis(2-Ethylhexyl)phthalate	0.4	10	4000
		4-Bromophenyl phenyl ether	0.35	10	Not Est.
		Butyl benzyl phthalate	0.35	10	Not Est.
		4-Chloroaniline	0.35	10	Not Est.
		2-Chloronaphthalene	0.35	10	Not Est.
		4-Chlorophenyl phenyl ether	0.35	10	Not Est.
		Chrysene	0.35	10	Not Est.
		Dibenz(a,h)anthracene	0.33	10	Not Est.
		Dibenzofuran	0.35	10	Not Est.
		Di-n-butylphthalate	0.4	10	Not Est.
		1,2-Dichlorobenzene	0.2	10	600
		1,3-Dichlorobenzene	0.2	10	Not Est.
		1,4-Dichlorobenzene	0.2	10	75
		3,3'-Dichlorobenzidine	1.6	10	Not Est.
		Diethyl phthalate	0.35	10	Not Est.
		Dimethyl phthalate	0.35	10	Not Est.
		2,4-Dinitroluene	0.35	10	Not Est.
		2,6-Dinitroluene	0.35	10	Not Est.
		Di-n-octylphthalate	0.35	10	Not Est.
		Fluoranthene	0.35	10	Not Est.
		Fluorene	0.35	10	Not Est.
		Hexachlorobenzene	0.35	10	1
		Hexachlorobutadiene	0.35	10	Not Est.
		Hexachlorocyclopentadiene	0.35	10	50
		Hexachloroethane	0.33	10	Not Est.
		Indeno(1,2,3-cd)pyrene	0.4	10	Not Est.
		Isophorone	0.33	10	Not Est.
		2-Methylnaphthalene	0.7	20	Not Est.
		Naphthalene	0.33	10	Not Est.
		2-Nitroaniline	1.7	50	Not Est.
		3-Nitroaniline	1.7	50	Not Est.
		4-Nitroaniline	1.7	50	Not Est.

MCL : Maximum Contaminants

Table B-4
(Continued)

Quantitation Limits For EPA Method 8270
Semi-Volatile Organic Compounds

Method	Parameter	Analytes	Maximum Quantitation Limits		MCL (ug/L)
			Soil (mg/kg)	Water (ug/L)	
8270	Base/ Neutral SVOCs	Nitrobenzene	0.33	10	Not Est.
		n-Nitrosodiphenylamine	0.9	10	Not Est.
		n-Nitrosodipropylamine	0.7	20	Not Est.
		Phenanthrene	0.35	10	Not Est.
		Pyrene	0.4	10	Not Est.
		1,2,4-Trichlorobenzene	0.33	10	Not Est.
	Acid	Benzoic acid	2	50	Not Est.
		4-Chloro-3-methylphenol	0.35	10	Not Est.
		2-Chlorophenol	0.4	10	Not Est.
		2,4-Dichlorophenol	0.4	10	Not Est.
		2,4-Dimethylphenol	0.4	10	Not Est.
		4,6-Dinitro-2-methylphenol	2	50	Not Est.
		2,4-Dinitrophenol	1.7	50	Not Est.
		2-Methylphenol	0.35	10	Not Est.
		4-Methylphenol	0.35	10	Not Est.
		2-Nitrophenol	0.4	15	Not Est.
		4-Nitrophenol	1.7	50	Not Est.
		Pentachlorophenol	1	30	Not Est.
		Phenol	0.4	10	Not Est.
		2,4,5-Trichlorophenol	1.6	50	Not Est.
		2,4,6-Trichlorophenol	0.35	10	Not Est.

MCL : Maximum Contaminants

Table B-5

**Quantitation Limits For Method TO-14
Volatile Organic Compounds**

Analyte	Reporting Limit (ppbv)
Benzene	0.5
Bromomethane	0.5
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	0.5
Chloroform	0.5
Chloromethane	0.5
3-Chloro-1-propene	0.5
Chlorotoluene	0.5
1,2-Dichlorobenzene	0.5
1,3-Dichlorobenzene	0.5
1,4-Dichlorobenzene	0.5
Dibchlorodifluoromethane	0.5
1,1-Dichlorethane	0.5
1,2-Dichloroethane	0.5
1,1-Dichlorethene	0.5
cis-1,2-Dichloroethene	0.5
1,2-Dichloropropane	0.5
cis-1,3-Dichloropropene	0.5
trans-1,3-Dichloropropene	0.5
1,2-Dichloro-1,1,2,2-tetraflouroethane	0.5
Ethylbenzene	0.5
Ethylene dibromide	0.5
Heptane	0.5
Hexachlorobutadiene	0.5
Methylene chloride	0.5
Styrene	0.5
1,1,2,2-Tetrachloroethane	0.5
Tetrachlorethene	0.5
Toluene	0.5
1,2,4-Trichlorobenzene	0.5
1,1,1-Trichloroethane	0.5
1,1,2-Trichloroethane	0.5
Trichloroethene	0.5
Trichlorofluoromethane	0.5
1,2,4-Trimethylbenzene	0.5
1,3,5-Trimethylbenzene	0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	0.5
Vinyl chloride	0.1
o-Xylenes	0.5
m- and p-Xylenes	0.5

C. ASSESSMENT/OVERSIGHT

C1 Assessments and Response Actions

C1.1 General

Technical assessments and performance audits are independent assessments of sample collection and analysis procedures. Audit results are used to evaluate a system's ability to produce data that fulfill program objectives and identify any areas requiring corrective action. Audits and data validation will be conducted by EPA and DNR personnel familiar with the objectives, principles, and procedures of the RI. All observations will be documented, and will be submitted to all PMs. This information and any corrective action documentation may be included in project reports, if deemed necessary. If significant concerns that would adversely affect the quality or usability of the data are identified during an audit which cannot be corrected, the regulatory agencies project manager will have the authority to suspend the work being conducted.

Audit records for contracting laboratories will be available for review by designated staff to determine whether laboratory data fulfill the program objectives. A systems audit or data validation for designated methods may be conducted, or additional information requested if data quality problems are indicated.

C1.2 Technical Systems Audit

A technical systems audit is an on-site, qualitative review of the field activities or analytical system. Audits are conducted, preferably at the beginning of the field or laboratory activity, by a qualified technical staff member from the regulatory agencies.

Critical items for an audit of field sampling activities include:

- Calibration procedures and documentation for field meters.
- Documentation of field activities in notebooks and on log sheets.
- Minimization of potential sample contamination in the field.
- Proper equipment decontamination procedures.
- Proper sample collection, storage, and transportation procedures.
- Compliance with chain-of-custody procedures for sample documentation and for transfer to the laboratory.

The laboratory audit results are used to review operations and ensure that the technical and documentation procedures provide valid data. Critical items for a laboratory systems audit include:

- Calibration procedures and documentation.
- Treatment and handling of standards.
- Completeness of data forms, notebooks, and other reporting requirements.
- Data review and verification procedures.
- Data storage, filing, and record keeping procedures.
- Sample custody procedures.
- Quality control procedures, control limits, and documentation.
- Operating conditions of facilities and equipment.
- Documentation of staff training and instrument maintenance activities.

Examples of standard laboratory and sampling audit checklists are included in Appendix B. It is the responsibility of the auditor upon completing the audit evaluation to prepare and submit a report which includes observations of strengths and deficiencies and recommendations for improvement.

C1.3 Data Validation

Data validation is performed to verify whether an analytical method has been performed according to method and program specifications, and the results have been correctly calculated and reported. Data validation involves reviewing all documentation, instrument output, and analytical reports associated with selected samples or groups of samples. Checklists are developed for each class of analytical methods (inorganics, GC, GC/MS) and used to document the validation process. The general procedures and examples of checklists are presented in SOP-028, Data Validation. Because data validation requires a comprehensive understanding of the analytical process, training and experience of validators is critical. The validator(s) should either have experience performing the method, or specialized training in reviewing the instrument output, evaluating calibration and QC data, and performing calculations and data reduction.

Examples of data validation forms are included in Appendix C. These include a data validation package checklist used to verify that all requested information has been received from the laboratory and an analytical data and report checklist used to document the completeness and quality of the information provided for each method. If a package is incomplete, the missing

information is requested from the laboratory before the validation can be completed. Specific items that are reviewed during data validation are:

- Chain-of-custody records.
- Documentation of laboratory procedures (e.g., standards preparation records, run logs, data reduction, and verification).
- Accuracy of data reduction, transcription, and reporting.
- Adherence to method-specific procedures and quality control parameters.
- Precision and accuracy of reported results.

C1.4 Audit Frequency

Audits will be conducted on all laboratory reports, all field sampling events, and when any project manager has concerns related to the nature of the data being collected.

C1.5 In-House Technical Systems Audits

HCI and Chemtech will routinely observe field operations to ensure consistency and compliance with the project plan objectives and documents. The project managers will also monitor adherence to technical requirements for laboratory analyses and data evaluation.

C2 Reports to Management

Following the completion of the proposed RI field work and the receipt of all analytical and supporting data, a report will be prepared documenting all the activities, findings, conclusions, and recommendations associated with the work conducted. Preliminary data will also be supplied to all project managers for discussion purposes, with the intention of being able to address changes in the project scope and direction as the work progresses. The RI report will include copies of all collected data, including laboratory reports with chain-of-custody records, borehole lithology logs, and applicable maps and tables.

All reports will be submitted to all the PMs within 90 days following the completion of the field activities. Each report will be prepared as a "Draft" for review by all project managers. Project managers are to submit any comments, in writing to the HCI Project Manager within 60 business days of receipt of the document. Within 30 business days of the receipt of comments, HCI's contractor will prepare a response which outlines how comments will be addressed. If no response to the "response to comments" is received within 30-days, it will be assumed that HCI comments are acceptable, and they will be incorporated into the report, which will be issued as a "Final" report.

If the recommendation specifies that additional work is required, new documents such as workplans will be prepared, or addendums to the existing documents will be prepared.

D. DATA VALIDATION AND USABILITY

D1. Data Review, Validation, and Verification Requirements

The purpose of this section is to present the criteria to determine the degree to which each data item outlined in the QAPP met its quality specifications. Any variation from the QAPP should be evaluated, and its effect on the data and the resulting interpretation determined. This includes ensuring that data has been collected, recorded, analyzed, and interpreted in the manner outlined in the QAPP and other project documents.

Data and procedural review is conducted at all stages of the project by all project peers. Final review is conducted by the Project Managers and the subcontractor management, (e.g. the Laboratory Manager).

D1.1 Sampling Design

Actual sampling locations and methodologies will be compared with the elements outlined in the Workplan, SAP, and QAPP. Any deviations from the plans will be reviewed to determine if the data obtained is acceptable to all parties, and meets the project objectives.

D1.2 Sample Collection Procedures

Validation activities should compare the actual sample collection procedures outlined in the QAPP and actual field activities. This includes such items as decontamination procedures and sampling equipment. Any deviations from the proposed plans will be reviewed to determine if the obtained data is acceptable, and meets the objectives of the project. Comments from EPA and DNR obtained during field surveillance should also be noted if applicable.

D1.3 Sampling Handling

The treatment and handling procedures from the sample collection to the laboratory and pre-analysis storage should be reviewed. This includes such items as sample labeling, chain-of-custody procedures, sample containers, sample preservation, and sample storage. Any deviations from Part B of this QAPP and the proposed plans will be reviewed to determine if the obtained data is acceptable and meets the objectives of the project.

D1.4 Analytical Procedures

The analytical procedures performed on the collected samples should verify that analytical procedures are in accordance with Part B of this QAPP. The routine QC procedures conducted in the laboratory are established in the published methods, this QAPP, and the analytical SOPs prepared by each laboratory. All analytical methods should be conducted in accordance with standard EPA Methods. Any deviations from Part B of this QAPP and the proposed plans will

be reviewed to determine if the obtained data is acceptable, and meets the objectives of the project.

D1.5 Quality Control

The QC provides for validation of sample collection, handling, and analysis. This includes analyses of standards, field and laboratory blanks, spikes, and field and laboratory duplicates. Any deviations from the QC procedures outlined in Part B of this QAPP and the proposed plans will be reviewed to determine if the obtained data is acceptable, and meets the objectives of the project.

D1.6 Calibration

Calibration records of both field and laboratory instruments and equipment should be reviewed. Deviations from calibration items in Part B of this QAPP and the proposed plans will be reviewed to determine if the obtained data is acceptable, and meets the objectives of the project.

D1.7 Data Reduction and Processing

All project data must be reviewed as part of data assessment. Data will be peer reviewed by a qualified person to check data integrity. The designated staff will perform data review and validation as designated in this QAPP, the project Workplan, and the Data Review and Data Validation (SOP-028).

D2. Validation and Verification Methods

All data will be validated in accordance with the Data Review and Data Validation (SOP-028) by the project QA/QC Manager. The retained laboratory will run required QA/QC samples in accordance with standard industry practices and EPA requirements.

The final review and approval of the data will be conducted by the Project Managers of both DNR and EPA. All Project Managers will review laboratory and field duplicates, matrix spikes, lab blanks, and any other appropriate QC data. The Project Managers will also review raw field data and compare it with final data for consistency and ensure that any anomalies in the data do not compromise the results.

D3. Reconciliation with User Requirements

Once the data collection has been completed, the RI Project Manager will evaluate all the data to determine if the objectives of the project have been met. It is also the role of the RI Project Manager to ensure the data meets the QA/QC standards outlined in this QAPP. If objectives are not met, or the QA/QC review identifies errors, additional investigations or resampling may be deemed necessary. Further, data evaluation will be conducted by the Project

Managers of the EPA and DNR. If any corrective action is deemed necessary, it will be discussed by all parties prior to being conducted.

APPENDIX A

Data Quality Objectives

INTRODUCTION

At the HCI-Chemtech Distribution, Inc. (Chemtech) facility at 139 Soper Street in St. Louis, Missouri, previous environmental investigations have determined that soil and ground water in particular areas of the site are contaminated with various chemicals. Prior investigations have identified the presence of volatile and semi-volatile organic compounds in the soil and ground water in the vicinity of the facility's main tank farm. In addition to these areas, there are areas of the facility where environmental concerns may exist based upon previous and current activities which have not been investigated. The proposed investigation will attempt to complete the data gathering phase of the investigation. The scope of the Remedial Investigation (RI) to be implemented is described in the RI workplan. Data Quality Objectives (DQOs) have been prepared to assist in assuring that the data obtained are accurate and representative of the conditions on site, and that the data will permit accurate conclusions to be made as the project moves forward. The following DQOs are prepared in accordance with EPA QA/G-4, Guidance for the Data Quality Process (EPA/600/R-96/055), September 1994.

In addition to Chemtech, the following organizations will have oversight for the project: HCI U.S.A. Distribution Companies, Inc. (HCI), the United States Environmental Protection Agency (EPA), and the Missouri Department of Natural Resources (DNR).

DQO1. SOIL

Three areas within the Chemtech St. Louis facility have been identified where soil contamination may be a potential threat to human health and the environment. These areas are, (A) tank farms 6 through 14; (B) a former diesel fuel underground storage tank (UST), adjacent to the facility office; and (C) a stormwater clarifier, in the area south of the facility's maintenance building.

DQO1A. TANK FARMS 6 THROUGH 14

STATEMENT OF PROBLEM

Description of Problem

With the exception of a release of caustic soda from Tank 28 in 1996, and a toluene/xylene release observed at Tank 7 during the moving of the tank, no releases of concern are known to have occurred in this area. However, to eliminate the potential of this area being a contaminant source area, evaluation of the soil is required. Based upon the results, additional action may be required.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the soil investigation is not expected to exceed \$20,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Questions

Is soil contamination present in the area of tank farms 6 through 14?

Alternative Actions That Could Result from Resolution of the Study

- a. Soil investigations indicate that leaks or spills have occurred which could result in subsurface contamination at a level which is a potential threat to human health or the environment and a risk assessment is necessary to determine if remedial action or further study is necessary.
- b. Soil contamination is not found at concentrations which are, by consensus of the planning team, a potential threat to human health and the environment, and no further action is necessary.
- c. No subsurface contamination is present, and no further action is required.

Decision Statement

Determine if soil contamination is present, and if it is at levels which would require a risk assessment to determine if remediation is necessary.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine the extent and concentrations of the soil contamination in the area at the site under investigation.

Determine the Sources for the Information

Information will be obtained from the collection and analysis of soil samples from the areas of potential concern. Collected soil samples will be analyzed for the potential chemicals in the area being investigated based upon historical activities in that area. Soil samples throughout the area being investigated will be analyzed for VOCs by EPA Method 8260, and any other required analysis based upon the content of the former tank in the sampling area.

Information Needed to Establish the Action Levels

Information needed to establish the action level is defined in the RI Workplan. This QAPP is Volume II of that Workplan. The information gathered will be used to determine if a risk assessment is required, and evaluate the need to conduct a remedial action.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits (see Section B of the QAPP) are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The soils to be investigated include the surface and near-surface soils in the area of the transfer valve at each of the former tank sites in tank farms 6 through 14 and the site of the existing tank in tank farm 13.

Spatial Boundaries

The soil investigation includes the sites of tank farms 6 through 13. The soils investigation will be restricted to the surface and near surface soils, with the boring for soil samples being restricted to a depth of three feet below ground surface (bgs).

Temporal Boundary

The investigation will determine the level of soil contamination present in the area investigated. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is the completion of the project within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the presence and concentrations of chemicals in the soils at the sites of the former tanks being investigated. This data will be integrated with the data collected for the site wide groundwater quality and the soil contamination in the other areas of concern on site to determine if a risk assessment is necessary.

Practical Constraints on Data Collection

With the exception of the tank farms, the area to be investigated has no structures. The proposed work is on land owned by Chemtech. With the exception of short-term constraints, such as inclement weather and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine the actual concentrations of the chemicals in the soil at the locations being investigated.

Action Level for the Study

The action level for the area being investigated will be determined after the RI and the risk assessment have been completed. If the concentration of any contaminant from the area of investigation exceeds the action level determined by the risk assessment, a remedial action will be conducted to reduce the level of contamination in the soil to a safe level.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data and the absence of final cleanup levels. A decision rule will be developed when the RI and risk assessment, if necessary, have been developed.

TOLERABLE LIMITS ON DECISION ERRORS

All of the results of analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established. The DQO will be revised after the risk assessment has been completed.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project in any individual area may be increased pending the results of the chemical analyses of the soil samples or the parameters defined in the risk assessment.

DQO1B. FORMER UNDERGROUND STORAGE TANK (UST)

STATEMENT OF PROBLEM

Description of Problem

There is no record of soil samples being collected and analyzed following the removal of the UST, or have any soil investigations been conducted in the vicinity of the former UST. It is therefore unknown if any soil contamination is presently associated with the UST.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the soil investigation is not expected to exceed \$15,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Is soil contamination present in the area that is the result of past operations of the UST?

Alternative Actions That Could Result from Resolution of the Study

1. Soil investigations indicate that leaks or spills have occurred which could result in subsurface contamination at a level which is a potential threat to human health or the environment and a risk assessment is necessary to determine if remedial action or further study is necessary.

2. Soil contamination is not found at concentrations which are, by consensus of the planning team, not a potential threat to human health and the environment, and no further action is necessary.
3. No subsurface contamination is present, and no further action is required.

Decision Statement

Determine if soil contamination is present, and if it is at levels which would require a risk assessment to determine if remediation is necessary.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine the extent and concentrations of soil contamination in the area being investigated.

Determine the Sources for the Information

Information will be obtained from the collection and analysis of soil samples from the areas of concern. Collected soil samples will be analyzed for the potential chemicals in the area being investigated based upon current and/or activities in that area. Soil samples from the area being investigated will primary be analyzed for total extractable petroleum hydrocarbons (TPH-E) by EPA Method 8015E and VOCs by EPA Method 8260.

Information Needed to Establish the Action Levels

Information needed to establish the action level is defined in the RI Workplan. This QAPP is Volume II of that Workplan. The information gathered will be used to determine if a risk assessment is required and evaluate the need to conduct remedial action.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits (see Section B of the QAPP) are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The extent of the soils to be investigated are limited to the location of the former diesel fuel UST.

Spatial Boundaries

The soil investigation will be limited to the location of the former diesel fuel UST. The soils investigation will be restricted to the vadose zone.

Temporal Boundary

The investigation will determine the level of soil contamination present in the area of the former diesel UST. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is completion of the sampling within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the presence and concentrations of chemicals in the soils within the area being investigated. This data will be integrated with the data collected for the groundwater quality and the soil contamination for the other areas of concern on site to determine if additional investigation or a risk assessment, is necessary.

Practical Constraints on Data Collection

The area to be investigated has no structures on it, although various structure are in close proximity, however, their presence will not affect the investigation. The investigation is on land owned by Chemtech. With the exception of short-term constraints, such as inclement weather and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine the presence, and if present, the actual concentrations of the chemicals in the soil.

Action Level for the Study

The action level for the area being investigated will be determined after the RI and the risk assessment have been completed. If the concentration of any contaminant from the area of investigation exceeds the action level determined by the risk assessment, a remedial action will be conducted to reduce the level of contamination in the soil to a safe level.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data and the lack of final cleanup levels. A decision rule will be developed when the RI and risk assessment, if necessary, have been developed.

TOLERABLE LIMITS ON DECISION ERRORS

All of the results of analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established. The DQO will be revised after the risk assessment has been completed.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project in any particular area may be increased pending the results of the chemical analyses of the soil samples or the parameters defined in the risk assessment.

DQO1C. STORMWATER CLARIFIER

STATEMENT OF PROBLEM

Description of Problem

There is no record of any soil investigation having been conducted in the vicinity of the stormwater clarifier. It is therefore unknown if any soil contamination is presently associated with the stormwater clarifier.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the soil investigation is not expected to exceed \$15,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Is soil contamination present in the area that is the result of present or past operations?

Alternative Actions That Could Result from Resolution of the Study

1. Soil investigations indicate that leaks or spills have occurred which could result in subsurface contamination at a level which is a potential threat to human health or the environment and a risk assessment is necessary to determine if remedial action or further study is necessary.

2. Soil contamination is not found at concentrations which are, by consensus of the planning team, not a potential threat to human health and the environment, and no further action is necessary.
3. No subsurface contamination is present, and no further action is required.

Decision Statement

Determine if soil contamination is present, and if it is at levels which would require a risk assessment to determine if remediation is necessary.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine the extent and concentrations of soil contamination in the area being investigated.

Determine the Sources for the Information

Information will be obtained from the collection and analysis of soil samples from the areas of concern. Collected soil samples will be analyzed for the potential chemicals in the area being investigated based upon current and/or activities in that area. Soil samples from the area being investigated will primary be analyzed for VOCs by EPA Method 8260 and TPH-E by EPA Method 8015E.

Information Needed to Establish the Action Levels

Information needed to establish the action level is defined in the RI Workplan. This QAPP is Volume II of that workplan. The information gathered will be used to determine if a risk assessment is required and evaluate the need to conduct remedial action.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits (see Section B of the QAPP) are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The extent of the soils to be investigated are limited to the location of the stormwater clarifier.

Spatial Boundaries

The soil investigation will be limited to the stormwater clarifier. The soils investigation will be restricted to the vadose zone.

Temporal Boundary

The investigation will determine the level of soil contamination present at the site of the stormwater clarifier. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is completion of the sampling within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the presence and concentrations of chemicals in the soils within the site being investigated. This data will be integrated with the data collected for the groundwater quality and the soil contamination for the other areas of concern on site to determine if additional investigation or a risk assessment, is necessary.

Practical Constraints on Data Collection

The area to be investigated has no structures on it, although various structure are in close proximity, however, their presence will not affect the investigation. The investigation is on land owned by Chemtech. With the exception of short-term constraints, such as inclement weather and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine the presence, and if present, the actual concentrations of the chemicals in the soil.

Action Level for the Study

The action level for the area being investigated will be determined after the RI and the risk assessment have been completed. If the concentration of any contaminant from the area of investigation exceeds the action level determined by the risk assessment, a remedial action will be conducted to reduce the level of contamination in the soil to a safe level.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data and the lack of final cleanup levels. A decision rule will be developed when the RI and risk assessment, if necessary, have been developed.

TOLERABLE LIMITS ON DECISION ERRORS

All of the results of analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established. The DQO will be revised after the risk assessment has been completed.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project in any particular area may be increased pending the results of the chemical analyses of the soil samples or the parameters defined in the risk assessment.

DQ02. RIVER SEDIMENTS

STATEMENT OF PROBLEM

Description of Problem

Due to the nature of the facility's business and that soil and groundwater contamination has been identified at the St. Louis facility, there is a concern that contaminant migration has resulted in an accumulation of contaminants in the near shore sediments in the Mississippi River.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the sediment investigation is not expected to exceed \$10,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Are chemical contaminants present in the near shore sediments in the Mississippi River, adjacent to the Chemtech St. Louis facility?

Alternative Actions That Could Result from Resolution of the Study

1. Chemical contaminants have accumulated in the near-shore river sediments adjacent to the St. Louis facility which are a potential threat to human health or the environment and a risk assessment is necessary to determine if remedial action or further study is necessary.

2. Chemical contaminants have accumulated in the near-shore river sediments. However, contamination is at a level which is, by consensus of the planning team, not a potential threat to human health and the environment, and no further action is necessary.
3. No contamination is present, and no further action is required.

Decision Statement

Determine if the near-shore river sediments are contaminated to a level which would require further action.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine if chemical residue has accumulated in the-near-shore river sediments, and if so, the nature and levels of the contamination.

Determine the Sources for the Information

River sediment samples will be collected from locations that are upstream and downstream from potential source areas, in addition to the a location adjacent to the property. Laboratory analysis of the samples will consist of VOCs by EPA Method 8260 and pH by EPA Method 150.1.

Information Needed to Establish the Action Levels

Information needed to establish the action level is defined in the RI workplan. This QAPP is Volume II of that Workplan. The information gathered will be used to determine if a risk assessment is required, and evaluate the need to conduct remedial action.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The medium of interest to be investigated is the near-shore river sediment adjacent to the Chemtech facility.

Spatial Boundaries

The Mississippi River forms the eastern boundary of the Chemtech St. Louis facility. Sediment samples will be collected within 10 feet of the river bank, at locations both upstream and downstream, as well as at the Chemtech property.

Temporal Boundary

The investigation will determine the level of contaminants present in the near-shore river sediment at the time of the sampling. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is completion of the project within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the presence and concentrations of chemicals in the near-shore river sediment, and to determine if a risk assessment and remedial action is required.

Practical Constraints on Data Collection

The medium to be investigated is the sediments of the Mississippi River. Access to the river can be obtained from the Chemtech facility. Access to a sampling locations directly upstream of the Chemtech facility is controlled by the USCG. With the exception of short-term limitations, such as unusual river levels, inclement weather, and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine the actual concentrations of the chemicals in the near-shore river sediments.

Action Level for the Study

The action level will be determined after the RI, and if needed, when a risk assessment has been completed.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data and the lack of final cleanup levels. A decision rule will be developed when the RI and risk assessment, if necessary, have been developed.

TOLERABLE LIMITS ON DECISION ERRORS

All of the results of analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until any risk assessment is completed and the action levels have been established. The DQO will be revised after the risk assessment has been completed.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project may be increased based on the field observations, identified; the results of the chemical analyses; or the parameters defined in any risk assessment.

DQO3. GROUND WATER

STATEMENT OF PROBLEM

Description of Problem

Groundwater sampling and analyses previously conducted at the facility has identified that the ground water across the facility is impacted with VOCs and semi-volatile organic compounds (SVOC). The SVOC have only been reported at low concentrations, whereas, the VOC are at levels of concern. The VOCs of particular concern have been benzene, toluene, xylenes, cis-1,2-dichloroethene, trichloroethene, and tetrachloroethene. The full extent of the groundwater contamination has not been fully defined.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the groundwater investigation is not expected to exceed \$60,000, plus an annual cost of approximately \$30,000 to conduct monitoring. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

The extent, concentrations, and distribution of the groundwater contamination at the facility are not fully known.

Alternative Actions That Could Result from Resolution of the Study

1. Based upon analytical results from the RI, additional monitoring wells and groundwater sampling points could be needed to assess the contamination.
2. Groundwater contamination is defined and is present at concentrations which could be a potential threat to human health or the environment and a risk assessment may be necessary to determine if remedial action is necessary.
3. Groundwater contamination is present, however, contamination is at a level and distributed in a manner which by consensus of the planning team is not a potential threat to human health and the environment, and no remedial action, other than monitoring, is necessary.

Decision Statement

Determine if groundwater contamination is present at levels which would require a risk assessment to determine if remediation is necessary.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is the concentrations and distribution of contamination in the ground water throughout the facility.

Determine the Sources for the Information

The sources for the information are groundwater samples from the monitoring wells as described in the RI Workplan. The groundwater samples will be analyzed as described in the RI.

Information Needed to Establish the Action Levels

Information needed to establish the action level is defined in the RI Workplan. This QAPP is Volume II of that Workplan. The information gathered will be used to prepare a risk assessment to determine the action levels.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of groundwater samples for environmental investigations. The detection limits are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The ground water in the water table aquifer is located under a chemical distribution facility that has been in operation for over 25 years.

Spatial Boundaries

The investigation is restricted to the Chemtech facility. Ground water from the watertable aquifer is to be investigated throughout the facility. The surface of the water table aquifer is controlled by the level of the river, but at normal river stage, ground water is approximately 25 feet bgs. The vertical distribution of any contaminants will be evaluated at two locations. Groundwater monitoring may be expanded to include select monitoring wells on the USCG facility, to the north of the Chemtech facility, if access can be obtained.

Temporal Boundary

The investigation will determine the level of contaminants present in the ground water at the time of the sampling. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is completion of the project within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the presence and concentrations of chemicals in the ground water. This data will be integrated with the data collected for the soils at the site and the previous studies.

Practical Constraints on Data Collection

A number of structures are present at the facility, however, their presence will not affect the RI. The RI is being conducted on land owned by Chemtech. With the exception of short-term constraints, such as inclement weather and availability of suitable equipment, there are no known constraints on data collection. There are no access constraints for groundwater monitoring activities on the Chemtech property, however, access to any wells on the USCG property is at the discretion of the USCG.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine the actual concentrations and distribution of the chemicals in the ground water at the Chemtech St. Louis facility.

Action Level for the Study

The action level will be determined after the RI and the risk assessment have been completed. If the concentration of any contaminant from the area of investigation exceeds the action level determined by the risk assessment, a remedial action will be conducted to reduce the level of contamination in the soil to a safe level.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data and the lack of final cleanup levels. A decision rule will be developed when the RI and risk assessment, if necessary, have been developed.

TOLERABLE LIMITS ON DECISION ERRORS

All of the results of analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established. The DQO will be revised after the risk assessment has been completed.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project may be increased pending the results of the chemical analyses of the groundwater samples or the parameters defined in the risk assessment.

DQO4. SURFACE WATER

Two areas associated with the Chemtech St. Louis facility have been identified where surface water contamination may be a potential threat to human health and the environment. These areas are, (A) the identified river bank seeps on the USCG property; and (B) the adjacent Mississippi River.

DQO4A. RIVER BANK SEEPS

STATEMENT OF PROBLEM

Description of Problem

Contaminated water has been observed seeping from the river bank into the river at the adjacent USCG property. No seeps have been observed on the Chemtech property. The source or the migrational path of the identified seep is unknown.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the investigation is not expected to exceed \$8,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Are chemical contaminants present in the water seeping from riverbank on the USCG facility, originating from the Chemtech St. Louis facility?

Alternative Actions That Could Result from Resolution of the Study

1. The chemical contaminants seeping into the Mississippi River are originating from the Chemtech facility and are at a level which are a potential threat to human health or the environment, and a risk assessment is necessary to determine if remedial action or further study is necessary.
2. The chemical contaminants seeping into the Mississippi River are originating from the Chemtech facility. However, contamination is at a level which is, by consensus of the planning team, not a potential threat to human health and the environment, and no further action is necessary.
3. The chemical contaminants seeping into the Mississippi River are not originating from the Chemtech facility, and no further action is required by Chemtech.

Decision Statement

Determine if the contaminated water seeping from the river bank on the USCG property originated from the Chemtech property, and if so, do contaminant levels warrant further action.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine if chemicals identified in the seep are the same as those in the ground water beneath the Chemtech facility, and identified subsurface structures are responsible for preferential migrational flow of the contaminants. Also, conduct a search of the river bank to identify any other seeps.

Determine the Sources for the Information

Samples from the seep on the USCG property will be collected for analysis and Chemtech will seek the assistance of the USCG to determine if any man-made structures, i.e. sewer line, are present which could cause preferential migrational flow. Chemtech will also inspect the river bank for additional seep areas. Any additional seeps will be sampled and subject to the same investigation as the identified seep.

Information Needed to Establish the Action Levels

The information gathered will be used to determine if the Chemtech facility is the source of the contamination identified in the seep, and if so, whether preparation of a risk assessment or corrective action is required which will determine the action levels and evaluate the need to conduct remedial action.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits are accepted as adequate to determine if chemicals are present at levels of concern. In addition, an evaluation of any man-made subsurface structures will be conducted to evaluate their affect on contaminant migration.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The medium of interest to be investigated is the contaminants within the seep on the USCG property, and any other identified seeps.

Spatial Boundaries

The only seep currently identified is on the riverbank of the Mississippi River on the USCG property, to the north of the Chemtech St. Louis facility. Inspection for additional seeps will be conducted along the complete river frontage of the Chemtech and USCG properties, and accessible other adjacent riverside properties.

Temporal Boundary

The investigation will determine the level of contaminants present in the identified seep at the time of the sampling, along with the presence of any current man-made subsurface structures. The time period during which the sampling occurs is not significant, but will be conducted during periods of low water level. The driving force for the time of sampling is completion of the project within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine the source, possible migrational route, and concentrations of the identified chemicals in the river bank seep on the USCG property and any other identified seeps, and determine if Chemtech needs to implement additional action.

Practical Constraints on Data Collection

The location of the identified seep is on property owned by the USCG. Prior to any sampling, Chemtech will have to obtain access approval from the USCG. In addition, Chemtech will require the assistance of the USCG to evaluate any man-made structures on USCG property which may be responsible for preferential flow. Once access is obtained from the USCG, with the exception of short-term constraints, such as high water levels, inclement weather, and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine a source of the identified chemicals in the river bank seep on the USCG property and a possible migrational path of the contaminants that are present.

Action Level for the Study

The action level will be determined after a source has been identified, all laboratory analysis associated with the RI conducted, and a risk assessment, if necessary, has been completed. If the source of the contaminants in the seep(s) is determine to have originated from the Chemtech property, and the concentration of any contaminant within the identified seep(s), exceeds the action level determined by the risk assessment, corrective action will be implemented to reduce the level of contamination in the waters of the seep(s) entering the river.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data, i.e. unknown source, and the lack of final cleanup standards. A decision rule will be developed following the completion of the RI and any risk assessment.

TOLERABLE LIMITS ON DECISION ERRORS

The results of all analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project may be increased based on the field observations, i.e. additional seeps identified, the results of the chemical analyses, or the parameters defined in the risk assessment.

DQO4B. RIVER WATER

STATEMENT OF PROBLEM

Description of Problem

It is unknown if the quality of the water in the Mississippi River is being affected by the contaminants identified at the Chemtech St. Louis facility.

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project managers for the EPA and DNR, and the primary environmental consultant for HCI.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the reasonable requirements of the EPA and DNR, and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost to conduct the investigation is not expected to exceed \$6,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Is the quality of the water in the Mississippi River impacted by the chemical contaminants identified in the soils and ground water of the Chemtech St. Louis facility?

Alternative Actions That Could Result from Resolution of the Study

1. The water of the Mississippi River adjacent to the Chemtech property is impacted to a level which is a potential threat to human health or the environment, and a risk assessment is necessary to determine if remedial action or further study is necessary.
2. The water of the Mississippi River adjacent to the Chemtech property is impacted. However, contamination is at a level which is, by consensus of the planning team,

not a potential threat to human health and the environment, and no further action is necessary.

3. The water of the Mississippi River adjacent to the Chemtech property is impacted. However, the source of the contamination is upstream of the Chemtech St. Louis facility, and Chemtech are not contributing to the contamination, and no further action is required by Chemtech.
4. The water of the Mississippi River adjacent to the Chemtech property is not impacted, and no further action is required.

Decision Statement

Determine if the water of the Mississippi River is impacted by the identified contamination at the Chemtech facility, and if so, do contaminant levels warrant further action.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine if chemicals identified in the soils and groundwater at the Chemtech facility are present in the water of the Mississippi River.

Determine the Sources for the Information

Samples of river water from accessible locations, upstream and downstream, as well as adjacent to the Chemtech will be collected. Collected water samples will be analyzed for all contaminants identified at the Chemtech St. Louis facility.

Information Needed to Establish the Action Levels

The information gathered will be used to determine if contamination identified at the Chemtech facility has impacted the water of the Mississippi River.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The medium of interest to be investigated is the water of the Mississippi River in the vicinity of the Chemtech St. Louis facility.

Spatial Boundaries

Sampling will be restricted to within 10 feet of the riverbank, both upstream and downstream, as well as adjacent to the Chemtech property.

Temporal Boundary

The investigation will determine the level of the contaminants in the water of the Mississippi River that have previously been identified in the soils and ground water of the Chemtech facility. The time period during which the sampling occurs is not significant. The driving force for the time of sampling is completion of the project within the schedule approved by the EPA and DNR.

Scale of Decision Making

The object of the investigation is to determine if the chemicals identified in the soils and groundwater at the Chemtech facility, are also present in the water of the Mississippi River, and whether they originated from the Chemtech property.

Practical Constraints on Data Collection

The proposed objective is to investigate the quality of the water of the Mississippi River adjacent to the Chemtech facility. Access to the river can be obtained from the Chemtech facility. Access to locations directly upstream of the Chemtech facility are controlled by the USCG. Prior to any sampling, Chemtech will have to obtain access approval from the USCG. Once access is obtained from the USCG, with the exception of short-term constraints, such as unsafe river conditions, inclement weather, and availability of suitable equipment, there are no known constraints on data collection.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine if the contamination identified at the Chemtech facility has impacted the quality of the water in the Mississippi River.

Action Level for the Study

The action level will be determined after all laboratory analysis associated with the RI have been completed, and a risk assessment, if necessary, has been completed. If the concentration of any contaminant is at a level of concern as determined by the risk assessment, corrective action will be implemented.

Decision Rule

A decision rule cannot be developed at this time because of insufficient data, and the lack of final acceptable standards. A decision rule will be developed following the completion of the RI and any risk assessment.

TOLERABLE LIMITS ON DECISION ERRORS

The results of all analyses must be acceptable within the quality control/quality assurance requirements of the laboratory methods specified. Beyond this step, the limits on errors cannot be determined until the risk assessment is completed and the action levels have been established.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project may be increased based on the field observations, the results of the chemical analyses, or the parameters defined in the risk assessment.

DQ05. AIR

STATEMENT OF PROBLEM

Description of Problem

Are vapor emissions associated with normal operations at the facility affecting general air quality in the general area of the facility?

Planning Team Members

The planning team will consist of the Corporate Environmental Manager for HCI, the Environmental Manager for Chemtech, the designated project manager from the local air management district, if applicable, and the primary environmental consultant for HCI. The DNR and EPA will be consulted as appropriate.

Primary Decision Maker

Decisions will be made by consensus, with the understanding that all decisions must conform to the requirements of the local Air Pollution Control Authority and the laws and regulations of the United States and the State of Missouri.

Available Resources and Relevant Deadlines

Chemtech will fund the cost of the investigation. The cost is believed to be approximately \$6,000. The schedule for the investigation is given in Section 9.0 of the RI Workplan. The schedule for reporting the results of the investigation is also given in Section 9.0 of the RI Workplan.

DECISIONS TO BE MADE

Principal Study Question

Are air emissions from the facility degrading local air quality?

Alternative Actions That Could Result from Resolution of the Study

1. Comparisons of upwind and downwind samples from the boundaries of the facility show that Chemtech operations are negatively impacting local air quality.
2. Comparisons of upwind and downwind samples from the boundaries of the facility show that Chemtech operations are not impacting local air quality.

Decision Statement

If air quality testings indicate that operation emissions are of concern and are impacting local air quality, emission controls will be evaluated.

Organize Multiple Decisions

Only one decision is being evaluated.

INPUTS TO THE DECISION

Information Required for the Decision

The information required is to determine air quality downwind of the Chemtech facility, and if local Chemtech operations are effecting the quality.

Determine the Sources for the Information

The sources for the information is laboratory analyses of ambient air samples collected from the boundaries of the facility in upwind and downwind locations. The samples of the emissions will be analyzed using Method TO-14.

Information Needed to Establish the Action Levels

The action level is the established limit of air quality goals as set by the local air management district.

Confirm That the Measurement Methods Will Provide the Necessary Data

The methods being used for the analyses are standard tools for the analyses of soil samples for environmental investigations. The detection limits are accepted as adequate to determine if chemicals are present at levels of concern.

BOUNDARIES OF THE STUDY

Characteristics of the Medium of Interest

The medium of interest is the air quality at upwind and downwind locations of the facility.

Spatial Boundaries

The boundaries of the study are upwind and downwind locations on the boundaries of the facility during prevailing wind conditions.

Temporal Boundary

The investigation will determine the air quality conditions at the time of the sampling. Sampling will be conducted during a period of normal operations.

Scale of Decision Making

The object of the sampling is to determine if Chemtech's operations are having a negative impact on local air quality.

Practical Constraints on Data Collection

Air samples are to be collected in open areas on the boundaries of the facility. Sampling will be conducted during a time of normal facility operations and summer type weather.

DECISION RULE

Specific Statistical Parameters Characteristic of the Population of Interest

The intention of the investigation is to determine what, if any, the normal operations of the Chemtech facility have on local air quality.

Action Level for the Study

The action level will be determined by the goals and objectives of the local air quality district.

Decision Rule

If the air quality testing indicates that the Chemtech operations are having a negative impact on air quality, air emission controls will be evaluated.

TOLERABLE LIMITS ON DECISION ERRORS

The results of the analysis must be within acceptable limits to meet quality control/quality assurance requirements of Method TO14. The levels of any contaminants within the air must be acceptable to the local air quality district.

OPTIMIZE THE DESIGN FOR OBTAINING DATA

The sampling proposed is adequate at this time. The scope of the project may be increased pending the results of the chemical analyses of the groundwater samples or the parameters defined in the risk assessment.

APPENDIX B

Examples of Standard Laboratory and Sampling Audit Checklists

TECHNICAL SYSTEMS CHECKLIST

Laboratory: _____

Date: _____

Section/Location: _____

GENERAL	Y/N	COMMENTS
Are laboratory SOPs maintained?	_____	_____
Are the SOPs available to personnel in the section?	_____	_____
Are adequate personnel in this area?	_____	_____
Are training records available?	_____	_____
Are qualified personnel in this area?	_____	_____
Are adequate facilities in this area?	_____	_____
Are the logbooks maintained in this area bound? legible? complete?	_____	_____
Are corrections dated and initialed?	_____	_____
Are all logbooks reviewed and signed by the supervisor?	_____	_____
Does a mechanism to track the sample information electronically exist?	_____	_____
What is the capacity of this area?	_____	_____
Describe the flow of sample(s) through this section.	_____	_____
Describe the responsibilities of this section.	_____	_____
Describe the review data. Who? When?	_____	_____
Additional Comments:		_____

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____ Date: _____

Section/Location: _____

SAMPLE CONTROL	Y/N	COMMENTS
Does the laboratory supply sampling kits?	_____	_____
Is the temperature of samples checked and documented at receipt?	_____	_____
Is the pH of preserved samples checked?	_____	_____
What is the corrective action for damaged or improperly preserved samples?	_____	_____
Is the temperature of the refrigeration system documented daily?	_____	_____
Does a mechanism for documenting removal or addition of samples to and from the refrigerators exist?	_____	_____
Do acceptance criteria and corrective action plans for the temperature maintenance exist?	_____	_____
Are back-up copies of the database made on a routine basis?	_____	_____
Do procedures for archiving data exist?	_____	_____
Can the original sample container be located from a masterlog? Sample Number: _____	_____	_____
Does a mechanism to track samples throughout the laboratory exist?	_____	_____
How long are samples stored after analysis?	_____	_____
Is the disposal of samples documented?	_____	_____

Additional Comments:

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____

Date: _____

Section/Location: _____

SAMPLE PREPARATION	Y/N	COMMENTS
Is the laboratory clean and organized?	_____	_____
Is glassware decontamination adequate?	_____	_____
Is an SOP for glassware washing posted?	_____	_____
Are the fume hoods periodically checked and recorded?	_____	_____
Does the laboratory have a source of deionized/distilled water?	_____	_____
Is the conductivity routinely checked and recorded?	_____	_____
Is appropriate measuring equipment used?	_____	_____
Are the balances calibrated yearly?	_____	_____
Is the balance routinely checked with "S" class weights of appropriate mass and the results recorded?	_____	_____
Are appropriate grades of chemicals used to prepare standards?	_____	_____
Are analytical standards prepared at a frequency to maintain integrity?	_____	_____
Are reference materials properly labeled with concentrations, preparation date, analysts' initials?	_____	_____
Can standards preparation be tracked through a logbook?	_____	_____
Does the log book include calculations, analyst source of standard materials, references, and expiration date?	_____	_____
Are standards stored separate from samples?	_____	_____
Are appropriate grades of reagents used?	_____	_____
Are reagent bottles properly labeled and dated?	_____	_____
Are oven temperatures recorded in a permanent log?	_____	_____
Are filters prerinsed and desiccated?	_____	_____

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____

Date: _____

Section/Location: _____

SAMPLE PREPARATION (cont.)

Y/N

COMMENTS

Does a mechanism to check the usability of desiccant exist?

Are equations for calculating analyte concentrations documented?

Additional Comments:

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____ Date: _____

Section/Location: _____

INSTRUMENTAL METHODS	Y/N	COMMENTS
Are manufacturer's operating manuals available to the analysts?	_____	_____
Does a documented preventative maintenance program exist?	_____	_____
Is service maintenance by contract?	_____	_____
Does an instrument maintenance logbook exist?	_____	_____
Are adequate replacement parts available in-house?	_____	_____
Is electronic data storage used?	_____	_____
Does permanent documentation of calibration standard preparation exist?	_____	_____
Can the calibration standards be traced?	_____	_____
Is the calibration frequency specified?	_____	_____
Are calibration acceptance criteria specified?	_____	_____
Is corrective action specified for failure to achieve calibration criteria?	_____	_____
Is the method detection limit checked on a regular frequency for each method?	_____	_____
Is there a second source calibration check?	_____	_____
Is corrective action specified for failure to achieve calibration acceptance criteria?	_____	_____
Is the method for determining the method detection limit specified?	_____	_____
Are specified internal QC checks specified for analytical procedures:	_____	_____
Laboratory blanks?	_____	_____
Duplicate samples?	_____	_____
Spike samples?	_____	_____

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____ Date: _____

Section/Location: _____

INSTRUMENTAL METHODS (Cont)	Y/N	COMMENTS
QC check samples?	_____	_____
Other?	_____	_____
Are frequencies clearly specified for each of the checks?	_____	_____
Are acceptance criteria specified for each of the internal QC checks?	_____	_____
Is corrective action specified for failure to achieve QC check criteria?	_____	_____
Are all data routinely assessed for precision and accuracy?	_____	_____
Does a corrective action for detection of target analytes in the blank exist?	_____	_____
What is the corrective action for samples that require reextraction and reanalysis?	_____	_____
Do supervisory personnel review the data and QC results?	_____	_____
Are calculations documented for each analytical method used?	_____	_____
Are data calculations spot-checked by a second person and initialed?	_____	_____
Are all dilution factors, reporting units, and narratives documented correctly?	_____	_____
Additional Comments:		

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____

Date: _____

Section/Location: _____

DOCUMENT CONTROL	Y/N	COMMENTS
Are laboratory data recorded in standard formats?	_____	_____
Are proper units reported?	_____	_____
Are proper detection limits reported?	_____	_____
Are sample dilutions documented?	_____	_____
Are soil samples reported on a dry weight basis?	_____	_____
Is one individual responsible for checking data transcriptions? Who?	_____ _____	_____ _____
Are back-up copies for raw data kept? For how long?	_____	_____
Are problems for anomalies noted on the data report?	_____	_____
Were all of the data required to verify the results in the data file? raw data? data of analysis? name of analysts? calculation of results? calibration data? instrument identification and operation conditions?	_____	_____
Were QC samples analyzed as specified in the QAPP?	_____	_____
Are QC data acceptable?	_____	_____
Were the data documented in a legally defensible manner?	_____	_____
Are the results for the number and type of samples identified on the report's cover sheet?	_____	_____
Do you have electronic data transfer?	_____	_____
Is electronic data transfer in the same system as production of hardcopy reports?	_____	_____
Are there different electronic data transfer formats?	_____	_____
Additional Comments: _____		

TECHNICAL SYSTEMS CHECKLIST (Continued)

Laboratory: _____ Date: _____

Section/Location: _____

QUALITY ASSURANCE/QUALITY CONTROL Y/N	COMMENTS
Does a laboratory QAPP exist? _____	_____
Does a specified frequency of updating control charts exist? _____	_____
Does an independent QA/QC entity exist? _____	_____
Does a QA training program for analysts exist? _____	_____
Are control charts used to evaluate performance? _____	_____
Does a laboratory "Statement of Qualification" exist? _____	_____
Do you have separate corrective action review? _____	_____
Are laboratory established control limits used for precision and accuracy? _____	_____
Do internal procedures for auditing the technical systems exist? _____	_____
Are PE samples submitted and reviewed? _____	_____
Does the lab have the capability of reporting different QC level data packages? _____	_____

Additional Comments: -

APPENDIX C
Data Validation Forms

HOLDING TIMES

Laboratory : _____

Analysis : _____

Reviewer : _____

[illegible]

Data Validation - EPA Method 8010

		Frequency	Yes	No	N/A	Samples Affected/Comments
1.0	Initial Calibration					
1.1	Was a 5-point calibration performed for each analyte of interest	Initial calibration prior to sample analysis				
1.2	Was one of the standards used for the 5-point near, but above method detection limit					
1.3	Was the Relative Standard Deviation <20% or was the correlation coefficient >99%					
1.4	Was a second source standard containing the analytes of interest analyzed	Once per 5-point				
General Comments						
2.0	Continuing Calibration					
2.1	Was working calibration curve verified at the start of the working day	Daily, before sample analysis				
2.2	Was response for every analyte within +/- 15% of average Calib' Fac/Resp Fac from the 5-point					
2.3	If limits were exceeded, was a new standard curve prepared? Were all samples analyzed after criteria were exceeded					
2.4	Was a mid-level standard analyzed at a 10% sample frequency and at end of analysis seq.?					
2.5	Did recoveries meet the required LCS limits					
General Comments						

Data Validation - EPA Method 8010

(cont)

		Frequency	Yes	No	N/A	Samples Affected/Comments
3	Retention Time (RT) Windows					
3.1	Was the GC System within optimum operating condition before RT Window study conducted					
3.2	Were 3 injections of all compounds performed throughout a 72-hour period	1, 72-hour study on each GC column & each new column				
3.3	Were RT windows est. at a +/-3X the Standard Deviation of absolute RT for each compound					
3.4	Were RT windows established for each column					
3.5	Were daily RT windows established for each analyte					
3.6	Did all succeeding standards in an analysis sequence fall within daily RT windows est.					
General Comments						
4.0	Demonstration of Capabilities					
4.1	Were multiple aliquots of a GC Check sample analyzed	Daily, before sample analysis				
4.2	Did these analyses meet the QC criteria established					
General Comments						

Data Validation - EPA Method 8010

(cont)

	Frequency	Yes	No	N/A	Samples Affected/Comments
5.0 Blank Analysis					
5.1 Was the method blank free of target analytes> the RDL? If not, what actions were taken?					
5.2 Were method blank surrogates RTs within established windows?					
5.3 Does the raw GC data support the reported blank results					
General Comments					
6.0 Surrogate Recoveries					
6.1 Do all surrogate recoveries met est. criteria	Every sample				
6.2 Does recalculations of surrogates recoveries verify the reported recoveries					
6.3 Does the raw data verify the reported recoveries curve prepared? Were all samples analyzed					
General Comments					
7.0 Laboratory Control Samples (LCS)					
7.1 Was a LCS analyzed prior to sample analysis?					
7.2 Did the % recovery fall within QC Standards?					
7.3 If LCS QC limits were exceeded, were corrective actions taken?					
7.4 Does the raw data verify the reported recoveries					
General Comments					

Data Validation - EPA Method 8010

(cont)

	Frequency	Yes	No	N/A	Samples Affected/Comments
8.0	Matrix Spike/Matrix Spike Duplicates				
8.1	Do all % recoveries and RPDs meet the specified specified limits?				
8.2	Does raw data verify the reported recoveries?				
General Comments					
9.0	Reported Detection Limits and Dilutions				
9.1	Have RDLs been adjusted to reflect sample dilutions, sample weight/volumes, clean-up and dry weight factors?				
9.2	Have sample results been quantitated within the calibration range?				
General Comments					
10.0	Analysis and Quantitation				
10.1	Do +ve identifications have dissimilar analysis?				
10.2	Are RTs of compounds and surrogates within the established RT windows?				
10.3	Was the average RF/CF from the 5-point used to quantitated results?				
10.4	Does raw data verify the reported results?				
General Comments					

Data Validation - EPA Method 8240/8260

		Frequency	Yes	No	N/A	Samples Affected/Comments
1.0	GC/MS Tuning					
1.1	Do the BFB tuning meet the ion abundance criteria?					
1.2	Was the BFB tuning run performed every 12 hours?					
1.3	Have the appropriate number of significant been reported?					
1.4	Mass assignment on raw data correct and mass listing is normalized					
1.5	Verify spectra were generated using correct background subtraction, if possible					
General Comments						
2.0	Calibration					
2.1	Was instrument calibrated initially after tuning criteria was met, prior to blank/sample analysis					
2.2	Were 5 initial standards run					
2.3	Was a continuous calib' standard run @ 50ppb					
2.4	Were all initial calibration values >0.3 for SPCC compounds					
2.5	Are initial RSD values <30% for CCC comp'					
2.6	Were all continuing calibration RRF values >0.30 for SPCC compounds					
2.7	Were all continuing calibration % Differences < 25% for CCC compounds					
2.8	Does recalculation of the RRF and RRF for one or more TCL compounds verify the values					

Data Validation - EPA Method 8240/8260

(cont)

		Frequency	Yes	No	N/A	Samples Affected/Comments
2.9	Does recalculation of the initial calibration % RSD for 1 or more TCL Compounds verify value					
2.10	Does recalculation of the % Diff between RRF and RRF verify the reported value					
General Comments						
3.0	Blanks					
3.1	Has a method blank been reported for each matrix & each GC/MS system					
3.2	Do the method blanks contain <5x RL for methylene chloride, acetone, 2-butanone					
3.3	Were field blanks collected for the sample set for each water source used?					
3.4	Do field blanks contain chemicals above the levels specified for method blanks					
3.5	Did a trip blank accompany each cooler containing VOC samples					
3.6	Was an equipment blank collected					
General Comments						
4.0	Surrogates					
4.1	Were surrogates added to all standards/samples					
4.2	Were surrogates recoveries for samples within project limits					

Data Validation - EPA Method 8240/8260

(cont)

		Frequency	Yes	No	N/A	Samples Affected/Comments
4.3	Are surrogate recoveries for blanks within these same limits					
General Comments						
5.0	Matrix Spike/Maatrix Spike Duplicate					
5.1	Was a MS/MSD analyzed at the prescribed freq					
5.2	Do% Recoveries fall within limits listed in QAPP					
5.3	Do RPD values fall within limits listed in QAPP					
5.4	Does recalculations of the % R and RPD values verify the reported values?					
General Comments						
6.0	Field Duplicates					
6.1	Were FD analyzed at 10% per matrix					
6.2	Was an equipment blank collected					
General Comments						
7.0	Internal Standards Performance					
7.1	Was an internal std. added to all std./samp/blk					
7.2	Was internal std conc. 50 ppb for each chem'					
7.3	Are sample IS retention within 30 sec of the continuing cal std IS retention time					
7.4	Are sample IS areas within a factor of 2 of the continuing cal std IS area					

Data Validation - EPA Method 8240/8260

(cont)

	Frequency	Yes	No	N/A	Samples Affected/Comments
General Comments					
8.0	Target Compound Verification				
8.1	Are sample RRTs within 0.06units of the std.RRT				
8.2	Are standard spectra similar to sample spectra				
8.3	Are sample spectra free of carry-over effects,esp if low concentrations samples are predated by high-concentration samples				
General Comments					
9.0	Compound Quantitation, Dilution and Reported Dection Limits				
9.1	Did dilution keep the largest analyte peak response for a target compound in the upper half of the initial calibration range				
9.2	Verify that data was submitted for no more than two analyses				
9.3	Verify that MS/MSD analyses were not diluted for the purpose of bring either spiked or non-spiked analytes within calibration range				
9.4	Verify that xylene peaks were quantitated, and if necessary diluted, separately				
9.5	Were the sample RRFs calculated based on the correct internal standard for that compound?				
9.6	Does recalculation of the compound quantitations verify the reported result				

Data Validation - EPA Method 8240/8260

(cont)

		Frequency	Yes	No	N/A	Samples Affected/Comments
9.7	Are the reported sample results, and quant reports free of transcription errors from the quant sheet, chromatograms, and sample prep log					
9.8	Have the RLs been adjusted for sample dilution, splits, clean-up activities, and dry weight factors					
	Are standard spectra similar to sample spectra					
General Comments						
10.0	System Performance					
10.1	Were abrupt, discrete shifts in the reconstructed ion chromatograph (RIC) found?					
10.2	Were shifts in absolute internal standard retention times found					
10.3	Was an excessive baseline rise of elevated temperature noted					
10.4	Were extraneous peaks noted for calibration standards					
General Comments						

**DRAFT
REMEDIAL INVESTIGATION
AND REMOVAL ACTION WORKPLAN**

VOLUME III

SAMPLING AND ANALYSIS PLAN

**for
HCI CHEMTECH DISTRIBUTION
139 East Soper Street
St. Louis, Missouri 63111**

Prepared for

**HCI-Chemtech Distribution
424 S. Woods Mill Road, Suite 325
Chesterfield, Missouri 63017**

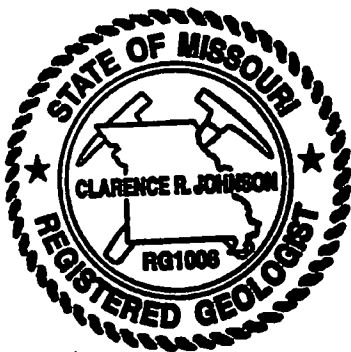
Prepared By

**C. Johnson Environmental
57 Amberwood Court
Moraga, California 94556**

June 1999

PROFESSIONAL CERTIFICATION

The Remedial Investigation and Interim Removal Action Workplan, the Quality Assurance Project Plan, the Sampling and Analysis Plan, the Standard Operating Procedures, and the Health and Safety Plan prepared for the HCI-Chemtech Distribution, Inc. site in St. Louis, Missouri were prepared under the direct supervision of Clarence Johnson, a Registered Geologist in the State of Missouri.



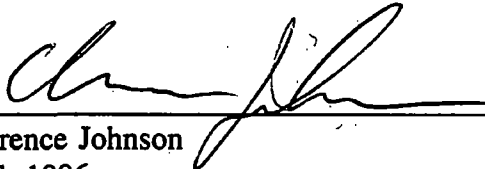

Clarence Johnson
R.G. 1006

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Distribution List:

Mr. Bryant K. Burnett	U.S. EPA
Ms. Julie Warren	Missouri DNR
Mr. Jeff Simko	HCI USA Distribution Companies, Inc.
Mr. Blake Tucker	HCI-Chemtech Distribution, Inc.
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Mr. Michael Sellens, RG	C. Johnson Environmental
Laboratory Manager	Environmetrics, Inc. (Subcontractor Laboratory)
Laboratory Manager	Air Toxics, Ltd. (Subcontractor Laboratory)

1.0 INTRODUCTION

HCI - Chemtech Distribution, Inc. (Chemtech), a wholly-owned subsidiary of HCI U.S.A. Distribution Companies, Inc. (HCI), operates four chemical distribution sites in Missouri. Two sites are located in Kansas City, the other two sites are in St. Louis and Springfield. To resolve a charge of illegally releasing sodium hydroxide into the Missouri River at one of the Kansas City sites, Chemtech signed a Plea Agreement in April 1997. As part of the requirements of that Plea Agreement, Chemtech agreed to adopt Corporate and Compliance Monitoring Programs (Monitoring Programs). The structure and scope of the Monitoring Programs is defined in a Compliance Agreement, which was prepared by the United States Attorney's Office, the United States Environmental Protection Agency (EPA) and the Missouri Department of Natural Resources (DNR). The Compliance Agreement was finalized on November 6, 1997.

Part A of the Compliance Agreement requires that a complete summary of all the data available on the environmental conditions be prepared for all of the Chemtech sites in Missouri. The purpose of the summaries is to provide the EPA and DNR with the environmental data available for the sites which will enable these agencies to determine if there are concerns at the sites which require additional environmental investigation. The summary report for the St. Louis facility was completed in January 1998 and submitted to the EPA and DNR for review.

Following the review of the summary report by the EPA and DNR, a meeting was held in August 1998 to develop a plan for further work at the Chemtech St. Louis facility at 139 East Soper Street. At that time, it was agreed that a Remedial Investigation (RI) would be undertaken to evaluate the contamination at the site.

This Sampling and Analysis Plan (SAP) outlines the proposed sampling and analysis associated with the RI activities. The purpose of the SAP is to ensure that sample collection activities are conducted in accordance with technically acceptable protocols and that the data collected in the field meet the requirements of the project objectives.

2.0 SITE BACKGROUND

Chemtech operates a chemical distribution facility located at 139 East Soper Street, St. Louis, Missouri 63111 (see Figure 2-1). The facility is located on the west bank of the Mississippi River and covers an area of approximately 14.9 acres. There are a total of 76 storage tanks at the facility, which are used to store a variety of chemicals, including aromatic solvents, ketones, alcohols, surfactants, heat transfer fluids, aliphatic solvents, glycols, and acetates. Dry bagged chemicals are also stored at the facility.

Full details regarding the environmental setting, ownership history, facility operations, and previous environmental studies associated with the St. Louis facility are presented in the RI Workplan.

3.0 SAMPLING OBJECTIVES

3.1 Areas of Concern

Previous investigations and research into the facility history have identified six areas associated with the facility where contamination is known to be present or there is a reasonable potential for soil and groundwater contamination to be present. For the purposes of the RI, the following areas have been designated for investigation:

1. The operations areas including the tank farms and the upgradient groundwater chemistry;
2. The former diesel fuel underground storage tank;
3. The stormwater clarifier;
4. Surface river water (Mississippi River);
5. Near-shore river sediments; and
6. Riverbank seeps.

3.2 Objectives of the Remedial Investigation

The RI is being conducted to complete the site characterization which was initiated under earlier programs. The objectives of the RI are to:

1. Define the concentrations and extent of chemicals in the soil and groundwater.
2. Define all source areas.
3. Characterize the stratigraphy.
4. Determine the direction and gradient of groundwater flow.
5. Determine if a Feasibility Study (FS) and Remedial Action Plan (RAP) are necessary.
6. Collect the data needed to prepare a FS, RAP, and a Risk Assessment (RA), if they are necessary.

To meet these objectives, both a soil and groundwater sampling program will be conducted. The objectives of the programs are outlined below.

3.2.1 Objectives of the Soil Sampling Program

The objectives of the soil sampling program are to ensure that all source areas have been identified, quantify the concentrations and extent of chemicals in the soil, determine if a FS, RAP, and RA are necessary, and obtain the data to conduct the FS, RAP, and RA, if deemed necessary. The actions which will be taken to accomplish these objectives are given below.

Previous soil sampling conducted at the facility has found chemicals released at the site to be present in the soil. In addition, three areas at the facility have been identified where preliminary soil sampling is required to assess the potential of soil contamination.

3.2.2 Objective of the Sediment Sampling Program

The objectives of the sediment sampling program are to determine if operational activities or the identified soil and groundwater contamination at the St. Louis facility has impacted the near-shore sediments in the Mississippi River. If the sediments have been impacted, the RI will quantify the concentrations and extent of chemicals in the sediments, and obtain the data to conduct the FS, RAP, and RA, if deemed necessary.

3.2.3 Objectives of the Groundwater Sampling Program

The objectives of the groundwater investigation are to ensure that all source areas have been identified, quantify the concentrations and extent of chemicals in the ground water, determine the direction and gradient of groundwater flow, determine if a FS, RAP, and RA are necessary, and obtain the data to prepare the FS, RAP, and RA, if deemed necessary. The rationale for establishing these objectives and the measures that will be taken to achieve the objectives are summarized in Section 6.0.

3.2.4 Objective of the Surface Water Sampling Program

The objectives of the surface water sampling program are to determine: (1) if the contamination identified in river bank seep on the adjacent US Coast Guard facility originated from the Chemtech facility; (2) if the soil and groundwater contamination at the St. Louis facility has impacted the waters of the Mississippi River; and (3) determine the appropriate actions if the impact to the Missouri River requires a remedial action.

4.0 SAMPLE LOCATION AND FREQUENCY

This section identifies each sample to be collected and the constituents to be analyzed. The locations of the samples are shown in Figure 3-1.

4.1 Soil Sampling

To obtain adequate information to complete the soil investigation at the St. Louis facility and to obtain a fuller understanding of the soil stratigraphy underlying the site, soil sampling will be conducted as described below. The quality assurance/quality control (QA/QC) procedures for the soil samples are given in the SAP, SOPs, and the QAPP. Boreholes will be drilled using the methods in SOP-004 for hollow stem augers. Shallow soil samples will be collected using the methods defined in SOP-016. Sample labeling is described in Section 5.0 of the SAP. Field screening procedures are described in Section 8.1 of the SAP. Sample handling and transportation is described in Section 7.0 of the SAP. Quality control for field and laboratory samples is described in Section B5 of the QAPP. Field instrument calibration is described in Section B6 of the QAPP. Details on the analytical methods are given in Section B4 of the QAPP and Section 8.0 of the SAP.

4.1.1 Tank Farms 6 through 14 Investigation

The contamination at the site appears to be near and upgradient of Tank Farms 6 through 14. The truck loading area upgradient of these tank farms and the blend tanks within the tank farms appear to be centers of contamination. In addition, the area at the east end of the tank farms may also be a center for contamination. Soil sampling as described in Section 5.0 of the Workplan and groundwater sampling as described in Section 6.0 of the Workplan will define the contamination in this area. In addition, the wells installed upgradient will further serve to localize the source(s) of contamination.

4.1.2 Former Diesel Underground Storage Tank

The investigation of possible contamination in the area of the former underground diesel storage tank will determine if releases have contaminated the soil in this area. Section 5.1.2 of the Workplan describes the soil sampling scheduled for the UST area.

4.1.3 Stormwater Clarifier

No releases have been reported in association with the stormwater clarifier. However, to assess the potential for the clarifier to act as a conduit for migration and concentration of releases at the site, soil samples will be collected as described in Section 5.1.3 of the Workplan and analyzed as described above.

4.2 Sediment Sampling

To obtain adequate information to determine if the near-shore sediments in the Mississippi River adjacent to the Chemtech St. Louis facility have been impacted, sediment sampling will be conducted as described below. The quality assurance/quality control (QA/QC) procedures for the sediment samples are given in the SAP, SOPs, and the QAPP. Sediment samples will be collected using the methods defined in SOP-016. Sample labeling is described in Section 5.0 of the SAP. Field screening procedures are described in Section 8.1 of the SAP. Sample handling and transportation is described in Section 7.0 of the SAP. Quality control for field and laboratory samples is described in Section B5 of the QAPP. Details on the analytical methods are given in Section B4 of the QAPP and Section 8.0 of the SAP.

4.3 Groundwater Sampling

To obtain adequate information to complete the groundwater investigation at the St. Louis facility and to obtain a fuller understanding of the shallow aquifer underlying the site, groundwater sampling will be conducted as described below. Monitoring wells will be installed using hollow-stem augers as described in SOP-004. Groundwater samples will be collected from both the existing and the proposed monitoring wells using the method described in SOP-013. Sample labeling is described in Section 5.0 of the SAP. Sample handling and transportation is described in Section 7.0 of the SAP. Quality control for field and laboratory samples is described in Section B5 of the QAPP. Field instrument calibration is described in Section B6 of the QAPP. Details on the analytical methods are given in Section B4 of the QAPP and Section 8.0 of the SAP.

Groundwater samples will be collected from the five existing monitoring wells on site to evaluate temporal changes in the water quality. The results of the analyses will also help to determine the rates of migration and natural degradation of the chemicals in the water. To help ensure that the data are comparable, the existing wells will be sampled at the same time as newly installed wells.

The samples collected from the existing wells will be analyzed using EPA Method 8260. Additional analyses, such as extractable hydrocarbons, may be added to the analytical schedule based on the sampling location. The complete sampling schedule is presented in the RI Workplan.

4.4 Surface Water Sampling

Surface water samples will be collected from the seep identified on the riverbank at the adjacent US Coast Guard facility, any other identified seep, and from the Mississippi River. Surface water samples will be collected as described in SOP-032. Sample labeling is described in Section 5.0 of the SAP. Sample handling and transportation is described in Section 7.0 of the SAP. Quality control for field and laboratory samples is described in Section B5 of the QAPP.

Field instrument calibration is described in Section B6 of the QAPP. Details on the analytical methods are given in Section B4 of the QAPP and Section 8.0 of the SAP.

4.4.1 River Bank Seep Sampling

Chemicals have been observed seeping from the river bank into the river at the Coast Guard property, particularly when the water level in the river is low. Similar seepage has not been observed on the Chemtech facility. However, the current inspection program to detect seeps from the Chemtech property will continue on a daily basis. If any seeps are observed, a sample of the seep will be collected for laboratory analysis. Samples will also be collected upstream of the seep and at the downstream side of the Chemtech property. All samples collected will be analyzed for VOCs by EPA Method 8260 and pH by EPA Method 150.

4.5 Air Sampling

To determine if air emissions which could present an environmental concern are leaving the site, air samples will be collected from upwind and downwind locations. The downwind location will be selected by walking the downwind boundary of the site with an OVM. The location of the highest OVM reading will be selected as the sampling point. The upwind location will be on the boundary of the site upwind from the downwind sampling point. The sample will be collected using the method described in SOP-017. The sample will be analyzed using Method TO-14. Sample labeling is described in Section 5.0 of the SAP. Sample handling and transportation is described in Section 7.0 of the SAP. Quality control for field and laboratory samples is described in Section B5 of the QAPP. Field instrument calibration is described in Section B6 of the QAPP. Details on the analytical methods are given in Section B4 of the QAPP and Section 8.0 of the SAP.

5.0 SAMPLE DESIGNATION

A standard sample identification (SampID) scheme has been developed to ensure consistent and unique sample numbers for all sampling locations. Each sample will be given a two letter designation to indicate the type of sample and a two number designation to indicate the location. The numbers on the samples will correspond to the numbered locations on Figure 3-1 in the SAP and Figure 6-1 in the RI Workplan. For samples added to the Workplan after the RI has been finalized, sample locations will be noted on a master field map and the locations described in the field log. Soil samples will have an additional two number extension to indicate the depth in feet of the sample. The sample type locations are listed below.

BS - Borehole soil sample
SS - Sediment Sample
SW - Surface water sample
MW - Monitoring well groundwater sample
AU - Ambient air upwind sample
AD - Ambient air downwind sample

In addition to the SampID, all samples will be labeled with the following information:

1. The client and site location (HCI Chemtech, St. Louis);
2. The date (M/D/Y) and time (24-hour clock) of sample collection; and
3. The initials of the sampler.

6.0 SAMPLING EQUIPMENT AND PROCEDURES

As part of the scope of work for the planned RI at the Chemtech St. Louis facility, soil, sediment, ground water, surface water, and air samples will be collected. This section outlines the sampling equipment and planned procedures for each of the sample types.

6.1 Soil Samples

Subsurface soil samples are to be collected using hollow stem augers drilling and sampling technology. Sample collection will be documented using sample logs and chain-of-custody forms as presented in Appendix A. Field data will be documented on lithological log sheets and in field notebooks, and sampling locations will be noted on site-specific maps. Lithologic logs will be prepared during all drilling operations. Samples will be collected using split-spoon samplers and soil tubes or will be taken directly from cuttings if sample return is insufficient to collect a sample. All these methods can be used to collect discrete or composite soil samples.

6.1.1 Sampling Criteria

At the Chemtech St. Louis facility, soil sampling will be conducted as outlined in the Workplan. Additional samples may be collected by field personnel if visual staining and odors are observed which may indicate high VOC concentrations in soil intervals.

6.1.2 Sample Compositing and Preservation

The use of sample compositing and preservation will be identified in the Workplan. Field sample compositing is performed only for soil samples submitted for nonvolatile parameter analysis. Compositing procedures are described in SOP-016 for soil sampling. Sample compositing for volatile parameter analysis is not performed due to potential loss of volatile chemicals.

6.1.3 Borehole Sample Collection Methods

Hollow-stem auguring is used with split-spoon sampling techniques to collect subsurface soil samples. Although the mechanics of collection differ, the actual sample obtained is the same for a wireline system, a surface drop hammer, or a wireline downhole drop hammer. All of these methods are described in SOP-004 and SOP-016.

6.1.4 Drill Cutting Disposal

Drill cuttings will be drummed in open top Department of Transportation (DOT) 55-gallon drums. All drums will be labeled and recorded (see Appendix A). Disposal of the drummed material will be dependent on the results of the analyses of the soil and ground water.

6.2 Sediment Samples

Sediment samples will be collected from near-shore locations in the Mississippi River. Sediment samples can be collected, using either a scoop, or dredge. Each technique allows for the collection of discrete samples. The actual sampling technique will be dependant on sampling location field conditions and the depth of the water. Based on expected field conditions, samples will be collected using a dredge, see SOP-015, Collection of Surface Soils/Sediment Samples in Ponds, Surface Impoundments, and Streambeds. Following sample collection, the sample is placed in a clean, laboratory supplied glass jar with a teflon-lined lid, and treated as described in the method for split spoon sampling.

6.3 Water Samples

6.3.1 Groundwater Monitoring Well Sampling

To evaluate groundwater quality at the facility and determine groundwater flow direction and hydrological gradient, groundwater parameters will be measured from the five existing and eight proposed groundwater monitoring wells. The procedures for sampling wells are summarized below.

- A. Measure the water level.
- B. Purge the well a minimum of three times the well's wetted volume. If the well is actively pumping, purging is not required.
- C. Monitor pH, specific conductance, and temperature to determine when well purging is adequate.
- D. Collect samples (including QC samples) for the designated analytical methods with procedures that minimize the potential for ambient contamination, cross-contamination, or loss of VOCs.
- E. Complete all sample collection documentation, prepare chain-of-custody forms, and ship the samples to the designated laboratory.

The detailed procedures are presented in the Groundwater Sampling SOP (SOP-013), and summarized below.

6.3.2 Water Level Measurements

Water levels will be measured using electronic water level meters and are reported to the nearest 0.01 foot. Measurements are taken from a reference notch on each well casing. If a light nonaqueous-phase liquid (LNAPL) is suspected, an "Oil Recovery Systems" probe or equivalent is to be used.

6.3.3 Purge Monitoring Parameters

All wells will be purged prior to the collection of any groundwater samples. Wells will be purged to remove standing water from the well casing and draw fresh formation water into the well. Monitoring parameters are measured to evaluate purging completeness; water levels are measured at the beginning of each sampling activity and immediately before samples are collected. All purging details will be recorded, see forms in Appendix A. Purging completeness is monitored by measuring pH, conductance, and temperature during purging and ensuring that these parameters are stable before any groundwater samples are collected. Stability is assumed when:

- pH measurements vary less than 0.1 pH unit;
- conductance measurements vary less than 5 percent; and
- temperature measurements vary less than 1.0 degree Celsius.

After these measurements have stabilized, and a minimum of three wetted casing volumes of water have been purged, groundwater samples can be collected. Special conditions that are exceptions to this protocol may occur and are addressed as follows:

- If the monitoring parameters do not stabilize, samples can be collected after six wetted casing volumes have been purged.
- If the well is purged dry before three wetted casing volumes have been removed, samples can be collected as soon as sufficient water enters the well.

6.3.4 Groundwater Sampling

All groundwater samples will be collected using well dedicated bailers in the appropriate sample containers, according to the planned analysis. Detailed activities are described in the SOP for Groundwater Sampling (SOP-013).

Groundwater sampling of a well under normal conditions is conducted when the well purging has been completed, and the water level in the well has returned to 90 percent of its original level. Groundwater sampling will be conducted using either a disposal dedicated bailer or reusable bailer (e.g. Teflon or stainless steel) which is cleaned and decontaminated between wells.

In addition to the samples collected for analysis, samples will also be collected for QA/QC purposes. These samples will include:

- Field Duplicates (FD) which consist of one sample for each 10 samples collected. FDs are from wells that have historically detected levels of contaminants.
- Field or Ambient Blanks (AB) are assigned to locations with differing conditions that may introduce VOCs to the samples, such as near busy roads, blending, and unloading areas. Field staff should make judgments about whether additional

ambient blanks are needed if atypical ambient conditions occur. The AB sample consists of a sample container filled at the facility during sampling activities with distilled water.

- Equipment Blanks should be collected after highly-contaminated wells have been sampled where reusable sampling equipment is used, following decontamination of the equipment. One laboratory supplied Trip Blanks should be collected for every shipment of VOC samples, or as designated in the Workplan.

6.3.5 Purge Water Disposal

Waste water collected during the purging of any monitoring well will initially be collected in DOT-approved 55-gallon drums. Upon receipt of the laboratory results of the ground water, the disposal of water will be determined.

6.3.6 Surface Water

Surface water samples will be collected from the seep on the US Coast Guard property, any other identified riverbank seeps, and of the waters of the Mississippi River. Samples will be collected directly into the sample container. Downstream locations will always be sampled first to minimize the chance of contaminating the soil with upstream sediments. Surface water samples are always collected prior to any sediment samples. The sampling procedures are presented in the Surface Water Sampling SOP (SOP-032). Surface water samples will be subject to the same sampling and analysis conditions for groundwater samples as presented in the QAPP.

6.4 Air and Vapor Sampling

As part of the project's scope, ambient air samples will be collected to evaluate general air quality associated with the facility and its operation.

Background air monitoring and sampling is conducted to evaluate general air quality associated with the facility and its operation. The scope for the proposed air sampling and the rationale for the location and nature of the samples collected are outlined in the RI workplan. Details associated with the equipment and procedures are included in SOP-017 and summarized below.

- As samples will be collected directly from the air no purging of equipment will be required if samples are collected in stainless steel Summa canisters. However, if any pumps or hosing is attached, purging of the required volume is conducted prior to the sample being collected.
- Sample collection is documented in the field log and on the chain-of-custody record. The results of any field screening results (i.e., organic vapor meter (OVM) readings) and weather conditions will be recorded.

6.5 Decontamination Procedures

All reusable field and sampling equipment that may contact samples must be decontaminated after each use. All decontamination liquids (water, solids) are collected in appropriate containers and are contained and disposed via either the sanitary sewer or off site at a licensed disposal facility. Equipment blanks will be collected at a frequency designated in the Workplan and QAPP to verify that decontamination has been effective or identify problems that could result in carryover and sample contamination.

6.5.1 Drill Rigs and Large Downhole Equipment

All drilling and sampling equipment will arrive at the facility clean. Between drilling and sampling locations, equipment will be decontaminated if deemed necessary, using steam cleaning or high-pressure hot water until visible dirt, grease, etc., has been removed. This may include the back portion of the drill rig, other large support equipment, auger flights, pipes, cables, and rods.

6.5.2 Sampling Equipment

Downhole and surface sampling equipment including drilling augers and split spoon samplers will be decontaminated between uses by the following procedures:

1. Scrub with water and laboratory-grade phosphate-free detergent (e.g., Alconox) to loosen any dirt or oily material (hose is not scrubbed).
2. Clean using a steam cleaner or high-pressure hot water until all visible traces of material have been removed.
3. Rinse with potable water.

If the split spoon sampler or hand auger is used without sleeves to collect samples for chemical analysis, these samplers are also rinsed in the same manner. Bailers, water level meters, submersible pumps, and other equipment that contact samples are decontaminated by the following procedures:

1. Scrub with water and laboratory-grade, phosphate-free detergent to loosen any dirt or oily material.
2. Rinse with potable water.
3. Rinse with deionized water (DI).

4. If deemed necessary, rinse with reagent-grade methanol and hexane. If the temperature is greater than 45 degrees F, methanol and cyclohexane may be used to reduce safety concerns associated with hexane exposure.
5. If metals cross contamination is of concern, rinse with 10 percent nitric acid.
6. Rinse again with DI water after solvents have dried to remove any residue
7. All decontaminated equipment is stored and transported in clean, decontaminated containers.

Soil sleeves and other sampling equipment are decontaminated by:

1. Scrub with water and detergent to loosen any dirt, grease, etc.
2. Rinse with potable water.
3. Rinse with DI water.
4. If deemed necessary, bake overnight in an oven, to remove any volatile compounds.

7.0 SAMPLE HANDLING

To fully characterize the site, soil, sediment, ground water, surface water, and air samples will be collected for laboratory analysis. All sampling and handling protocols will be handled according to EPA specifications.

7.1 Sample Containers

Sample containers will be purchased and pre-cleaned and treated according to EPA specifications for the appropriate methods. Sampling containers that are reused (e.g., soil sleeves) will be decontaminated between uses by the procedures described in Section 6.4. Cleaned containers will be stored separately to prevent exposure to fuels, solvents, and other chemicals. Tables 7-1 and 7-2 lists sample storage and preservation requirements for each method and matrix.

7.2 Sample Custody and Documentation

Sample possession during all sampling efforts must be traceable from the time of collection until the results are verified and reported by the laboratory and the samples are disposed. Sample custody procedures provide a mechanism for documenting information related to sample collection and handling. Each step or aspect of sample custody and documentation is described in this section.

7.2.1 Documentation Procedures

The lead field geologist is responsible for ensuring that field sampling personnel adhere to proper custody and documentation procedures. Pre-formatted field data and chain-of-custody forms are the primary documentation mechanisms used to record and track information about each sample. In addition, personal or field team logbooks may also be maintained.

Field data form examples are included in Appendix A. The SOPs list specific information that must be recorded for each field activity. Copies of the chain-of-custody and field data forms will be retained in the project files. Field personnel have the following responsibilities:

- Keep accurate written records of sample collection activities on the field forms and logbooks.
- Ensure that all entries are legible, written in waterproof ink, and contain accurate and inclusive documentation of the field activities including field data and observations, problems encountered, and actions taken to solve the problem.
- Date and initial daily entries.
- Note errors or changes using a single line to cross out the entry, and date and initial the change.
- Complete chain-of-custody forms accurately and legibly.

Field forms and logbooks will be available for review during technical systems audits or at any other time for quality control (QC) checks. This documentation provides verification of sampling procedures.

7.2.2 Sample Labels and Identification

A sample label is affixed to each sample collected. Sample labels uniquely identify the sample with an identification number, the sample type (ground water, soil), analytical method requested, the sampler's name(s), date collected, and the preservation method used. These labels will be completed with a permanent marker.

The labels will be waterproof pressure-sensitive labels or adhesive paper labels. Samples will be placed in Ziplock bags for shipment and storage to prevent loss or damage caused by melting ice or broken or leaking samples. Use of additional tape to secure the sample labels is not recommended because of the potential for sample contamination from volatiles in the adhesives. The standard sample identification scheme is described in Section 5.0.

7.3 Chain-of-Custody Forms

Sample information is recorded by designated field personnel, with assurance that all necessary information is recorded. The chain-of-custody forms will be prepared prior to sample shipment or release.

A chain-of-custody form is completed prior to shipment or release. The form will include information for samples collected by the sampling personnel. An example of a chain-of-custody form is included in Appendix A. Information that may be included on the chain-of-custody forms includes:

- Sample identification;
- Date and time of collection;
- Sampler(s') initials;
- Analytical method(s) requested;
- Sample volume (e.g., three 40 ml vials);
- Sample matrix (e.g., soil or ground water);
- Preservative (e.g., HCl);
- Signature blocks for release and acceptance of samples; and
- Any comments to identify special conditions or requests.

Completion of sample custody forms and sample packaging for shipment is performed at the facility. Designated field personnel shall complete and verify chain-of-custody forms and pack samples for shipment at the end of each sampling day. If samples will be collected for on site laboratory analysis, the sample control designee or field team member logs in the samples and releases them to the on site laboratory. Sample transfer between supplier staff or between supplier staff and courier, laboratory, etc. is documented by signing and dating "relinquished by"

and "received by" blocks whenever sample possession changes. Samples will be released for shipment by overnight couriers by noting the airbill number in the signature block. If samples are not shipped on the collection day, they are refrigerated or stored on ice in coolers in the sample control area.

7.4 Sample Shipment and Handling

All sample shipments will be accompanied by the chain-of-custody record, which identifies the content. The original accompanies the shipment and a copy is retained in the project file. If any samples are split for duplicate analysis, a separate chain-of-custody record is prepared. The person relinquishing the samples to the facility or agency requests the signature of a representative to acknowledge sample receipt. When appropriate, as in the case of overnight shipment, the custody record should contain a statement that the samples were delivered to the designated location and the date and time noted. Sample collection and shipment are coordinated to ensure that the receiving laboratory has staff available to process the samples according to method specifications.

All shipping containers will be secured for transportation to the laboratory. The method of shipment, courier name(s), and other pertinent information is entered in the "Remarks" section when the samples are to be shipped (i.e., Federal Express) instead of hand delivered.

When samples are required to be stored at 4 degrees C or less, generous amounts of ice are packed with the samples. The ice must contact each sample and be approximately two inches deep at the top and bottom of the cooler. The ice may be contained in Ziplock bags, but must contact the samples to maintain temperature. Samples will be cooled with ice or in a refrigerator before being packed for shipment. When the samples are delivered to the laboratory they are placed in the sample control cooler immediately after log-in. The following procedures are used to prevent bottle breakage and cross-contamination

- Sample bottles are individually sealed in plastic Ziplock bags.
- All samples are transported inside hard plastic coolers.
- All glass bottles/containers are wrapped in packing material to prevent glass-to-glass contact.
- Ice and/or foam blocks are used to separate glass bottles.
- The coolers are taped shut and sealed to prevent accidental opening.
- Samples that are known or suspected to be highly contaminated (based on field screening data or observation) are packaged and shipped separately from other samples.
- Laboratory sample control is notified of any known or suspected highly-contaminated samples. These samples are stored separately from less-contaminated samples to minimize the potential for contamination.

7.5 Laboratory Custody Procedures

Each laboratory follows sample control and log-in procedures. Sample tracking systems and assignment of responsibility varies among laboratories, however, the following sample control activities must be conducted in each laboratory:

- Initial sample log-in and verification of samples received with the chain-of-custody form.
- Record on the chain-of-custody any problems or discrepancies during log-in.
- Initiate internal laboratory custody procedures.
- Verify sample preservation, such as sample temperature and pH.
- Notify the project manager if any problems or discrepancies are identified.
- Proper sample storage, including daily cooler temperature monitoring, collection of refrigerator blanks, segregation of highly-contaminated samples, separate storage of volatile samples, and sample security.
- Notify laboratory personnel of unusual conditions or special requests for sample handling or analysis.
- Distribute samples or notify laboratory or area supervisors of sample arrival.
- Return shipment of coolers and used samples (if disposal has been previously arranged).

8.0 SAMPLE ANALYSIS

All samples collected in the field will be subject to field screening and analysis. Based upon these results and the project scope as presented in the Workplan, select samples will be submitted for laboratory analysis.

8.1 Field Screening

All samples will be subject to field screening. This will consist primary of headspace analysis, using a portable vapor analyzer, with either a photoionization detector (PID) or a flame ionization detector (FID). Calibration and operation of these instruments are outlined in SOP-020 and SOP-021. The protocols for conducting headspace analysis are as follows:

- Half fill a sealable container (Ziplock bag or glass jar) with the sample.
- Seal container. If jar is being used, cover mouth with foil sheet, prior to lid.
- Allow sample to sit in warm area, i.e. in sun, for a minimum of 10 minutes
- Insert probe into container, minimizing the size of the hole in the foil or bag. Do not allow probe to be in contact with sample.
- Read and record result from analyzer.

It should be noted that field screening values are not validated results and are only an indicator of contaminants. However, by maintaining a standard process, and comparisons with actual analytical results, some basic interpretations may be made.

8.2 Laboratory Analysis

The contaminants previously identified at the Chemtech St. Louis facility consist of VOCs and SVOCs. Although not previously identified as contaminants extractable hydrocarbons and pH concerns may also be present associated with chemicals that have been stored at the facility in the past. Laboratory analysis will be limited to chemicals stored at the site, for which there are regulatory standards. In additional, select samples will be analyzed for heavy metals. Based upon this criteria laboratory analyses of soil, sediment, and water samples will be limited to extractable hydrocarbons by EPA Method 8015E; VOCs by EPA Method 8260; SVOC by EPA Method 8270; and pH by EPA 150.1. Air samples will be analyzed by Method TO-14, with acetone.

8.2.1 EPA Method 8015E, Extractable Hydrocarbons

Extractable petroleum hydrocarbon (TPH) components, mineral spirits, oils, and heavier molecular weight petroleum products will be analyzed using extraction by Method SW3550, followed by GC analysis with a flame ionization detector (FID).

Extraction Method SW3550, is a procedure for extracting nonvolatile organic compounds and semivolatile organic compounds (SVOCs) from solids such as soils. A weighed sample of

the soil or sediment is mixed with anhydrous sodium sulfate, then dispersed into the solvent with sonication. The extract is gravity or pressure filtered and concentrated. The resulting solution is analyzed directly using the appropriate technique. Methylene chloride is typically used as the solvent, although other solvents may be used for specific analytical applications.

8.2.2 EPA Methods 8260, Volatile Organics

VOCs in water and soil samples may be analyzed using Methods 8260. These methods consist of a purge-and-trap gas chromatography/mass spectrometry (GC/MS) technique. Method SW5030 is used to remove the VOCs from the sample matrix onto an adsorbent trap. The trap is backflushed and heated to desorb the purgeable organics onto a GC, where the organics are separated and subsequently detected with a mass spectrometer. The method analytes and QLs for these methods are listed in the QAPP.

8.2.3 EPA Method 8270, Semivolatile Organics Analysis

SVOCs, also known as base/neutral and acid extractables (BNA), are analyzed using EPA Method 8270 in water and soil samples. This technique is used to determine the concentration of a number of SVOCs. Organic compounds are extracted from the sample with methylene chloride at pH greater than 12 to obtain base/neutral extractables. Acid extractable compounds are obtained by a second extraction with methylene chloride after the pH has been adjusted to two or less. Both base/neutral and acid extracts are then concentrated by removing methylene chloride through evaporation. Compounds of interest are separated and quantified using a GC/MS. A list of the chemicals detected with the quantitation limits for the method are presented in the QAPP.

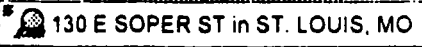
8.2.4 EPA Method 150.1, pH

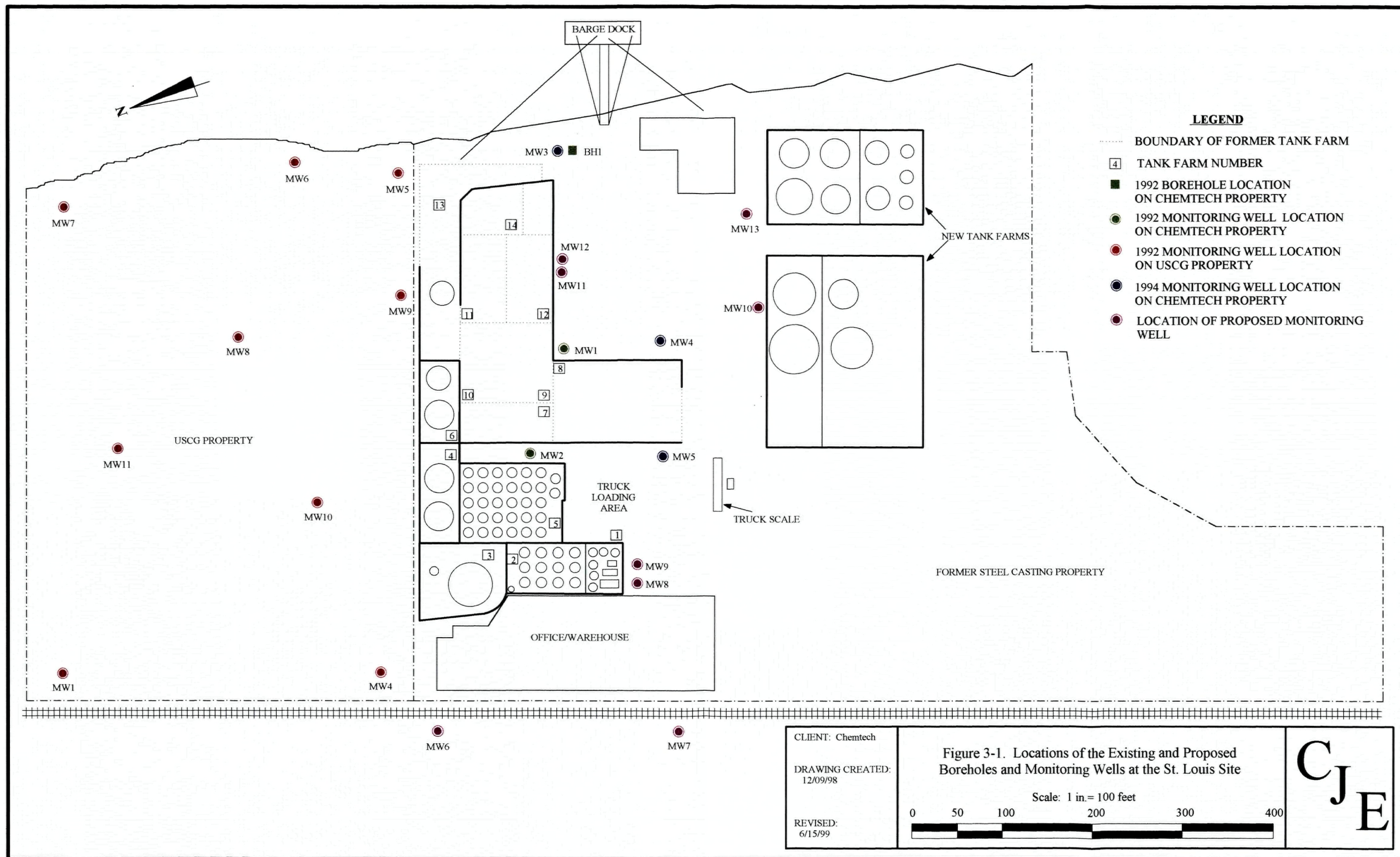
The pH of water samples can be measured in either the field or a laboratory. The pH of soil samples is measured in the laboratory only. All measurements are determined electrometrically using either a glass electrode combined with a reference potential or a combination electrode. Meters are calibrated daily using a minimum of two buffer solutions.

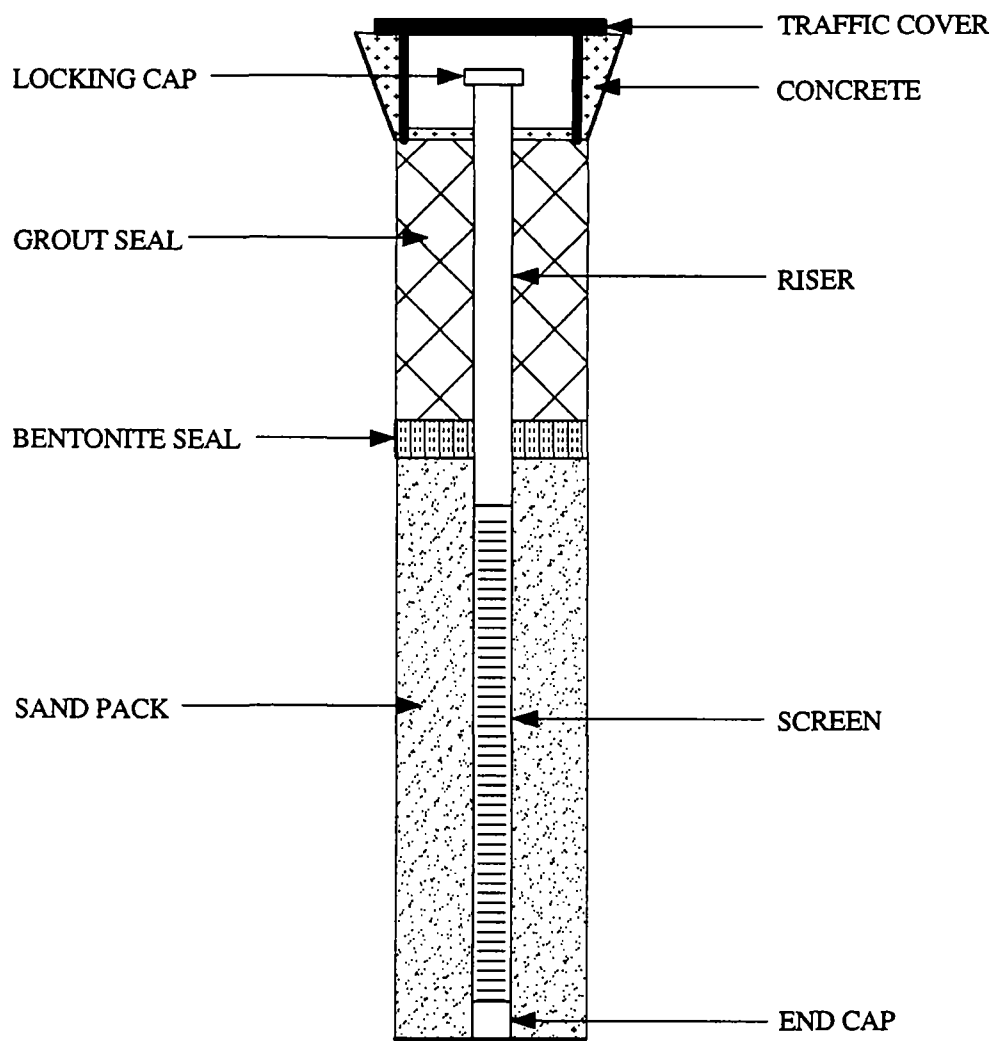
8.2.5 Method TO-14 GC/MS Analysis of Air

VOCs in ambient air are measured using Method TO14 with evacuated stainless steel Summa canister sampling and GC analysis.

After a sample is received from the field and logged into the laboratory system, the canister pressure and temperature are measured. Nitrogen is added to the canisters to provide positive pressure for removing the sample, to dilute oxygen and moisture in the sample, and to minimize sample component reactions. Quantitation limits for Method TO-14 are listed in the QAPP.


$$C_{JE}$$





CLIENT:
CHEMTECH

DRAWING CREATED:
11/16/98

REVISED:

Figure 7-1. Typical Monitoring Well Construction

No Scale

C
J
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Table 7-1

Sample Storage and Preservation Requirements : Soil and Groundwater Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Extractable Hydrocarbons	EPA8015E	14-days	1x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Purgeable Halocarbons	EPA8010	14-days	3x40ml Glass Vials Sleeve or 8oz jar	None	4 degrees C
Purgeable Aromatics	EPA8020	14 days	3x40ml Glass Vials Sleeve or 8oz jar	None	4 degrees C
Purgeable Organics	EPA8240/8260	14 days	3x40ml Glass Vials Sleeve or 8oz jar	pH <2, with HCL	4 degrees C
Base/Neutral and Acid Extractables	EPA 8270	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Metals	EPA 6010	6 months	Sleeve or 8oz jar 1x500ml Poly'Bottle	None pH<2, with HNO3	4 degrees C
Mercury	EPA 7470/7471	28 days	Sleeve or 8oz jar 1x500ml Poly'Bottle	None pH<2, with HNO3	4 degrees C
Organochlorine Pesticides	EPA 8080	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Organophosphorus Pesticides	EPA 8141	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Chlorinated Herbicides	EPA 8151	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
pH	EPA 150.1/SW9045	Field Test (w) ASAP (s)	500ml Poly Bottle 250ml Glass Jar	None	4 degrees C

Table 7-2

Sample Storage and Preservation Requirements : Air Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Total Non-Methane Hydrocarbons	TO12	14 days	Summa Canister	None	None
Volatile Organic Compounds	TO14	14-days	Summa Canister	None	None

Table 7-1

Sample Storage and Preservation Requirements : Soil and Groundwater Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Extractable Hydrocarbons	EPA8015E	14-days	1x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Purgeable Halocarbons	EPA8010	14-days	3x40ml Glass Vials Sleeve or 8oz jar	None	4 degrees C
Purgeable Aromatics	EPA8020	14 days	3x40ml Glass Vials Sleeve or 8oz jar	None	4 degrees C
Purgeable Organics	EPA8240/8260	14 days	3x40ml Glass Vials Sleeve or 8oz jar	pH <2, with HCL	4 degrees C
Base/Neutral and Acid Extractables	EPA 8270	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Metals	EPA 6010	6 months	Sleeve or 8oz jar 1x500ml Poly'Bottle	None pH<2, with HNO3	4 degrees C
Mercury	EPA 7470/7471	28 days	Sleeve or 8oz jar 1x500ml Poly'Bottle	None pH<2, with HNO3	4 degrees C
Organochlorine Pesticides	EPA 8080	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Organophosphorus Pesticides	EPA 8141	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
Chlorinated Herbicides	EPA 8151	7 days until Extraction (w) 14 days until Extraction (s) 40 days after Extraction	2x1liter Amber Bottl Sleeve or 8oz jar	None	4 degrees C
pH	EPA 150.1/SW9045	Field Test (w) ASAP (s)	500ml Poly Bottle 250ml Glass Jar	None	4 degrees C

Table 7-2

Sample Storage and Preservation Requirements : Air Samples

Reference Parameter	Method(s)	Holding Time	Containers	Preservations	Storage Requirements
Total Non-Methane Hydrocarbons	TO12	14 days	Summa Canister	None	None
Volatile Organic Compounds	TO14	14-days	Summa Canister	None	None

APPENDIX A

Forms

WELL CONSTRUCTION

Location : _____

Well ID : _____

Date Installed : _____

Geologist : _____

Drilling Contractor : _____

Driller : _____

Drilling Method : _____

Rig Type : _____

Condition of Ground Surface : _____

Formation Screened : _____

Project Number : _____

Ground Elevation : _____

Well Casing Elevation : _____

Protector Casing Elevation : _____

Location Sketch

Bit Type	Hole Dia (inch)	End Dept (feet)	Drill Fluid

Protector, Casing & Screen Record

Description	Diameter (inch)	Tot. Leng (feet)	Top* (feet)	Bottom* (feet)

Completion Materials Record

Description	Top*	Bottom*

Comments

Time Log

Activity	Date	Start	End
Drilling			
Casing			
Filter Pack			
Seal			
Grout			
Development			
Survey			
Other			

Groundwater Levels

During Drilling

Well Development

* From ground surface

[illegible]

Monitoring Well Purge Table

Well ID : _____ Date : _____ Location : _____

[illegible]

Groundwater Monitoring Data Sheet

DRUM INVENTORY RECORD

[illegible]

**DRAFT
REMEDIAL INVESTIGATION
AND REMOVAL ACTION WORKPLAN**

VOLUME IV

**HEALTH AND SAFETY PLAN
FOR
HCI-Chemtech Distribution, Inc.
139 East Soper Street
St. Louis, Missouri 63111**

Prepared for:

**HCI Chemtech Distribution, Inc.
424 S. Wood Mill Road, Suite 325
Chesterfield, Missouri 63017**

Prepared by:

**C. Johnson Environmental
57 Amberwood Court
Moraga, California 94556**

June 1999

PROFESSIONAL CERTIFICATION

The Remedial Investigation and Interim Removal Action Workplan, the Quality Assurance Project Plan, the Sampling and Analysis Plan, the Standard Operating Procedures, and the Health and Safety Plan prepared for the HCI-Chemtech Distribution, Inc. site in St. Louis, Missouri were prepared under the direct supervision of Clarence Johnson, a Registered Geologist in the State of Missouri.





Clarence Johnson
R.G. 1006

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Distribution List:

Mr. Bryant K. Burnett	U.S. EPA
Ms. Julie Warren	Missouri DNR
Mr. Jeff Simko	HCI USA Distribution Companies, Inc.
Mr. Blake Tucker	HCI-Chemtech Distribution, Inc.
Mr. Clarence Johnson	C. Johnson Environmental
Mr. Michael Sellens, RG	C. Johnson Environmental
Laboratory Manager	Environmetrics, Inc. (Subcontractor Laboratory)
Laboratory Manager	Air Toxics, Ltd. (Subcontractor Laboratory)

1.0 INTRODUCTION

1.1 Background

C. Johnson Environmental (CJE) is conducting a subsurface investigation on behalf of HCI Chemtech Distribution, Inc. at their facility located at 139 East Soper Street in St. Louis, Missouri 63111, see attached Figure. This Health and Safety Plan (HSP) is solely for the planned environment remedial investigation (RI) at the Chemtech, Soper Street facility. This HSP does not replace the facility's existing HSP and should be used as a supplement to Chemtech's HSP.

1.2 Site Characterization

Client Name: HCI Chemtech Distribution, Inc.,
Location of Site: 139 East Soper Street, St. Louis, Missouri 63111
Client Contact Person(s): Blake Tucker

Topography of the area surrounding the site:

Hilly ____ Flat X Hummocky ____ Marsh ____ Mountainous ____ Other ____

Area affected:

Urban ____ Rural ____ Residential ____ Industrial X
Commercial ____ Other ____

Types of bodies of water bordering the site, if any:

Stream ____ River X Pond ____ Lake ____ Bay ____ Ocean ____
Other ____ None ____

Are the services being provided as a consequence of orders from local, state, or federal officials?

Yes X No ____

1.3 Purpose

The primary purpose of the site safety plan is to provide field personnel and subcontractors with an understanding of the potential chemical and physical hazards that exist or may arise while the tasks of this project are being performed. Secondly, the information contained herein will define the safety precautions necessary to respond to such hazards should they occur.

1.4 Objective

The primary objective is to ensure the well-being of all field personnel and the community surrounding the site. In order to accomplish this, project staff and approved subcontractors shall acknowledge and adhere to the policies and procedures established herein. Accordingly, all personnel assigned to this project shall read this site safety plan and sign the Agreement Statement in Section 8.1 to certify that they have read, understood, and agreed to abide by its provisions.

1.5 Hazard Determination

Serious _____ Moderate _____ Low X Unknown _____

1.6 Level of Protection

 X Modified Level D

The minimum acceptable level of protection at this site is a Modified Level D, as described in the 5.0 Section entitled "Health and Safety Requirements."

1.7 Amendments

Any change in the scope of this project and/or site conditions must be amended in writing in the 8.2 Section entitled "Site Safety Plan Amendment Sheet" and approved by the Health and Safety Manager.

Proposed time frame for the site work: Summer 1999.

2.0 PROJECT PERSONNEL

A representative of CJE will oversee and act accordingly during all phases of the project. The following management structure will be instituted for the purpose of safely completing this project.

2.1 Project Manager: Clarence Johnson, R.G.

The Project Manager will be responsible for implementing the project and obtaining the necessary personnel and resources for the project completion. Specific duties will include:

- providing authority and resources to ensure that the Site Safety Officer is able to implement and manage safety procedures;
- preparing reports and recommendations about the project to clients and other concerned parties directly related to the project;
- ensuring that all persons allowed to enter the site (i.e., the United States Environmental Protection Agency (EPA), contractors, state officials, visitors) are made aware of the potential hazards associated with the substances known or suspected to be on site and are knowledgeable as to the on-site copy of the specific site safety plan;
- ensuring that the Site Safety Officer is aware of all of the provisions of this site safety plan and is instructing all personnel on site about the site practices and emergency procedures defined in the plan; and
- ensuring that the Site Safety Officer is making an effort to monitor the site safety and has designated a Field Team Leader to assist with the responsibility when necessary.

2.2 Health and Safety Manager: Michael P. Sellens, RG.

The Health and Safety Manager shall be responsible for the overall coordination and oversight of the site safety plan. Specific duties will include:

- approving the selection of the types of personal protective equipment (PPE) to be used on site for specific tasks;
- monitoring the compliance activities and the documentation processes undertaken by the Site Safety Officer;
- evaluating weather and chemical hazard information and making recommendations to the Project Manager about any modifications to work plans or personal protection levels in order to maintain personal safety;
- coordinating upgrading or downgrading of PPE with Site Safety Officer, as necessary, due to changes in exposure levels, monitoring results, weather, or other site conditions;
- approving all field personnel working on site, taking into consideration their level of safety training, their physical capacity, and their eligibility to wear the

- protective equipment necessary for their assigned tasks (i.e. respirator fit testing results);
- overseeing the air-monitoring procedures as they are carried out by site;
- monitoring the compliance activities and the documentation processes undertaken by the Site Safety Officer;
- evaluating weather and chemical hazard information and making recommendations to the Project Manager about any modifications to work plans or personal protection levels in order to maintain personal safety;
- coordinating upgrading or downgrading of PPE with Site Safety Officer, as necessary, due to changes in exposure levels, monitoring results, weather, or other site conditions;
- approving all field personnel working on site, taking into consideration their level of safety training, their physical capacity, and their eligibility to wear the protective equipment necessary for their assigned tasks (i.e. respirator fit testing results); and
- overseeing the air-monitoring procedures as they are carried out by site personnel for compliance with all company health and safety policies.

2.3 Site Safety Officer: Michael P. Sellens R.G.

The Site Safety Officer shall be responsible for the implementation of the site safety plan on site. Specific duties will include:

- monitoring the compliance of field personnel for the routing and proper use of the PPE that has been designated for each task;
- routinely inspecting PPE and clothing to ensure that it is in good condition and is being stored and maintained properly;
- stopping work on the site or changing work assignments or procedures if any operation threatens the health and safety of workers or the public;
- monitoring personnel who enter and exit the site and all controlled access points;
- reporting any signs of fatigue, work-related stress, or chemical exposures to the Project Manager and/or Health and Safety Manager within 24 hours;
- dismissing field personnel from the site if their actions or negligence endangers themselves, co-workers, or the public and reporting the same to the Project Manager and/or Health and Safety Manager within 24 hours;
- reporting accidents or violations of the site safety plan to the Project Manager and/or Health and Safety Manager within 24 hours;
- knowing emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire and police departments;
- ensuring that all project-related personnel have signed the personnel agreement and acknowledgments form contained in this site safety plan;
- coordinating upgrading and downgrading of PPE with the Health and Safety Manager, as necessary, due to changes in exposure levels, monitoring results, weather, and other site conditions; and

- performing air monitoring with approved instruments in accordance with requirements stated in this Site Safety Plan.

2.4 Field Team Leader

In the event that the Project Manager or the Site Safety Officer are not on the site, the Field Team Leader will assume all responsibility for enforcing safety procedures.

2.5 Field Personnel

All field personnel shall be responsible for acting in compliance with all safety procedures outlined in this site safety plan. Any hazardous work situations or procedures should be reported to the Site Safety Officer so that corrective steps can be taken. The Health and Safety Manager and/or Site Safety Officer has the authority to halt any operation that does not follow the provisions of this Site Safety Plan.

3.0 EMERGENCIES

In the event of an accident or emergency situation, immediate action must be taken by the first person to recognize the event. First aid equipment is located on site inside the Subcontractor's vehicle. Immediately after emergency procedures are implemented, notify (1) the Site Safety Officer and (2) the Chemtech facility management about the situation.

3.1 Emergency Telephone Numbers

Immediate Emergencies:

Local Police:	911
Fire:	911
Ambulance:	911
Medical:	911

Medical Emergency:

Lutheran Medical Center
2639 Miami Street
St. Louis, Missouri 63118-3928
(314) 772-1456

Environmental Emergency:

HCI Chemtech (Site):	(314) 832-5048
HCI Corporate:	(714) 974-4908
C. Johnson Environmental:	(925) 376-2861
	(916) 966-8502
Missouri Dept. of Natural Resources:	(573) 751-8629
Missouri Dept. of Natural Resources Emergency Spill Number:	(573) 634-2436
US Environmental Protection Agency:	(913) 551-7540
Poison Information Center:	911

3.2 Encountering Hazardous Situations (requiring evacuation)

Personnel encountering a hazardous situation shall **instruct others on site** to evacuate the vicinity **IMMEDIATELY** and contact the (1) Facility Management, (2) Site Safety Officer, (3) the Project Manager, and (4) the Health and Safety Manager for instructions.

The site must not be re-entered until the situation has been corrected (i.e., appropriate back-up help, monitoring equipment, personal protective equipment is at the site).

Usual Procedures for Injury

- A. Call for ambulance/medical assistance if necessary. Notify the receiving hospital of the nature of the physical injury or chemical overexposure. If a telephone is not available, transport the person to the nearest hospital.
- B. Send/take this site safety plan with the attached Material Safety Data Sheet (MSDS), if available, to medical facility with the injured person.
- C. If the injury is minor, proceed to administer first aid.
- D. Notify the Site Safety Officer, Project Manager, Health and Safety Manager, the facility management, and HCI of all accidents, incidents, or near miss situations.

3.3 Emergency Treatment

When transporting an injured person to a hospital, bring this site safety plan to assist medical personnel with diagnosis and treatment. In all cases of chemical overexposure, follow standard procedures as outlined below for poison management, first aid, and if applicable, cardiopulmonary resuscitation. Four different routes of exposure and their respective first aid/poison management procedures are outlined below:

- A. Ingestion:
IMMEDIATELY transport the person to the nearest medical facility, or call the poison control center at **911**
- B. Inhalation/Confined Space:
DO NOT ENTER A CONFINED SPACE TO RESCUE A PERSON WHO HAS BEEN OVERCOME UNLESS PROPERLY EQUIPPED AND A STANDBY PERSON IS PRESENT.
- C. Inhalation/Other:
Move the person from the containment environment. Initiate cardio pulmonary resuscitation (CPR), if necessary, call, or have someone call, for medical assistance. Refer to MSDSD for additional specific information. If necessary, transport the victim to the nearest hospital as soon as possible, see attached Figure.
- D. Skin Contact:
IMMEDIATELY wash off skin with a large amount of water. Remove any contaminated clothing and rewash skin. Transport person to a medical facility, if necessary, see attached Figure.

- E. **Eyes:**
Hold eyelids open and rinse the eyes **IMMEDIATELY** with copious amounts of water for 15 minutes. If possible, have the person remove his/her contact lenses (if worn). Never permit the eyes to be rubbed. Transport the person to a hospital as soon as possible, see attached Figure.

4.0 CHEMICALS OF CONCERN

The following list of chemicals are either known or are potential known to be present at the Chemtech Soper Street facility, and were considered during the preparation of this site safety plan:

- Aromatic hydrocarbons, i.e., toluene, xylenes
- Halogenated hydrocarbons, i.e., tetrachloroethylene, trichloroethylene
- Semi-volatile organic compounds, i.e., naphthalene
- Polyaromatic hydrocarbons (PAH)
- Caustics

The potential for acute toxic effects from these compounds at the subject property is low. While these chemicals are only slightly to moderately toxic by acute exposure, chronic exposures to some of these chemicals can result in carcinomas. The semi-volatile organic compounds, are thought to be an insignificant threat to human health at the subject property due to the low concentrations in which they have been identified.

Details regards the physical properties and the health risks associated with the major chemicals of concern are presented in Appendix A.

5.0 HEALTH AND SAFETY REQUIREMENTS

5.1 Work Zone Access

Access within a 20-foot radius of any on site operation is prohibited to all but field personnel directly involved in the project, personnel of the regulatory agencies, and subcontractors. Standard work practices, such as performing field activities in the upwind position, will be observed whenever possible. Personal protective equipment indicated in Section 5.4 will be worn by all on site field personnel, including the subcontractor's personnel.

Exclusion Zones

Formal exclusion zones are not expected to be required. The site is fenced and will remain so throughout the planned field activities. Unauthorized personnel will not be permitted near the work zone area.

Decontamination Zone

A formal decontamination zone may be required. It would be positioned in the upwind direction from the work zone area. At the current time, no formal decontamination zone is planned or believed to be necessary. Decontamination procedures are covered in Section 5.5. All site personnel will be required to follow the procedures.

Support Zones

No formal requirements will be necessary for the support zone area, although the general practice of locating the zone in the upwind direction will be followed.

5.2 Air/Gas/Vapor Monitoring Procedures

The greatest potential hazards to safety and health at this site include:

1. Exposure to chemical vapors - through inhalation.
2. Exposure to chemical contamination - through skin contact and ingestion.

Ongoing air monitoring using an organic vapor analyzer with a photoionization detector (PID) during project tasks will provide data to ensure that vapor concentrations are within acceptable ranges and will provide adequate selection criteria for respiratory and dermal protection.

- If PID readings exceed 25 units, an air purifying respirator with organic cartridges must be worn by all site workers within any area where monitoring results exceed 25 units.

- If PID readings exceed 250 units, Level B protection will be required. Personnel must leave the site immediately and contact the Site Safety Officer or the Health and Safety Manager for further instructions.
- Each respirator cartridge will be used no more than one day. If odor breakthrough is detected while wearing the respirator or breathing becomes difficult, cartridges will be changed immediately.

5.3 Action Levels/Level of Personal Protection Equipment (PPE)

Air monitoring instrument units	LEVEL D <25 units	LEVEL C 25-250 units	LEVEL B >250 units
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5.4 Personal Protective Equipment

Modified Level D is the minimum acceptable level for this site. Modified Level D provides minimal dermal protection. Respiratory protection is optional unless air monitoring data indicates otherwise.

A. Modified Level D includes:

- Coveralls/work uniform;
- Tyvek (optional);
- Nitrile butyl-rubber or Viton gloves (optional);
- boots/shoes, leather or chemical resistant, with approved toe protection;
- approved safety glasses or chemical splash goggles if the potential for splash exists;
- hard hat;
- reflective traffic vest (if traffic, construction, or other related activities are present); and
- hearing protection (as appropriate).

B. Additional equipment upgrade:

1. Protocols for upgrading.
Once air monitoring data are complete and results are tabulated on the initial site entry, the Site Safety Officer and/or Health and Safety Manager will determine if changes in PPE are needed.
2. Upgraded equipment
 - a. Respirators with organic vapor cartridges shall be worn by all personnel if PID readings exceed 25 units.
 - b. Tyvek suits and appropriate gloves shall be worn if potential for dermal exposure exists while performing job tasks.

C. First Aid Equipment

Vehicles used for site work will be equipped with a first aid kit and safety equipment may include:

- cones and flags;
- barricades;
- fire extinguisher;
- water, suitable for drinking; and
- portable eye wash.

5.5 Decontamination Procedures

All operations conducted at this site have the potential to contaminate field equipment and (PPE). To prevent the transfer of any contamination to vehicles, administrative areas, and other personnel, the following procedures must be followed:

1. Whenever possible, field equipment should be decontaminated with a solution of Alconox or Green Soap and thoroughly rinsed with water prior to leaving the site. This must be done outside a five foot radius of any work area or the hot zone.
2. Disposable PPE (for example, Tyvek suits, respirator cartridges) must be bagged and disposed of at the site.

Personal Decontamination

Level D: Segregated Equipment Drop

- wash/rinse outer boot (as appropriate);
- wash/rinse chemical resistant outer glove, then remove as appropriate; and
- remove and throw out inner disposable gloves in designated, lined receptacles.

Level C: Segregated Equipment Drop

- wash/rinse outer boots;
- wash/rinse chemical resistant outer gloves, then remove tape and gloves;
- remove chemical resistant suit (remove by rolling down suit from the inside);
- remove outer boots;
- remove first pair(s) of disposable gloves;
- remove respirator, hard hat/face shield and properly dispose of cartridges;
- wash respirator; and
- remove last pair of disposable gloves.

Level B: Segregated Equipment Drop

- wash/rinse outer boots;
- wash/rinse chemical resistant outer gloves;
- cross hotline (into clean area) and change air tanks, then redress or cross hotline (into clean area);
- remove boots and gloves;
- remove self-contained breathing apparatus (SCBA), if worn over chemical resistant suit;
- if SCBA is worn under the suit, remove the chemical resistant suit, then the SCBA; and
- remove hard hat.

5.6 Drilling Procedures

Prior to conducting any drilling operations, the local public underground utility locating service will be contacted for the purpose of locating any underground utilities. In addition, available site plans will be reviewed to locate utilities. If required, boreholes will be relocated, a minimum of five feet from any underground utilities. If any concerns exist, a private locating service may be retained or the initial five feet will be hand augured.

During the drilling operation, two persons (one designated as the "driller" and the other as the "helper") must be present at all times. The helper (whether field personnel or subcontractors) must be instructed as to the whereabouts of the emergency shut-off switch for the drilling equipment. Every attempt must be made to keep unauthorized personnel from entering the work area. If this is not possible, the operation should be shut down until the area is cleared. The Site Safety Officer or the Field Team Leader has the authority and responsibility to shut down the operations whenever a hazardous situation is deemed present.

The mast of the drilling equipment should maintain a preferred clearance of 20 feet from any overhead electrical cables, with 10 feet being the minimum. All drilling operations will immediately cease during any hazardous weather conditions. Hard hats and protective foot wear shall be worn at all times.

5.7 Electrical Equipment and Ground Fault Circuit Interrupters

All electrical equipment and power cables used in and around wells or structures containing chemical contamination must be explosion-proof and/or intrinsically-safe and equipped with a three-wire ground lead that has been rated as explosion-proof for hazardous atmospheres (Class 1 Div 1&2). In accordance with the Occupational Health and Safety Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926.404, approved ground fault circuit interrupters (GFCI) must be utilized for all 120 volt, single-phase, 15 and 20 amp receptacle outlets on the site that are in use by employees and that are not part of the permanent wiring.

Receptacles on the ends of the extension cords are not part of the permanent wiring and therefore must be protected by GFCIs whether or not the extension cord is plugged into permanent wiring.

The GFCI is a fast-acting circuit breaker that senses small imbalances in the circuit caused by current leakage to the ground, and in a fraction of a second, shuts off the electricity. However, the GFCI will not protect the employee from line-to-line contact hazards such as a person holding two "hot" wires or a hot and neutral wire in each hand. The GFCI does provide protection against the most common form of electrical hazard - the ground fault. It also provides protection against fires, overheating, and destruction of wire insulation.

GFCIs can be used successfully to reduce electrical hazards on construction sites. Tripping of GFCIs and interruption of current flow is sometimes caused by wet connectors and tools. It is good practice to limit exposure of connectors and tools to excessive moisture by using watertight or sealable connectors. Providing more GFCIs on shorter circuits can prevent tripping caused by the cumulative leakage from several tools or by leakage from extremely long circuits, (Adapted from OSHA 3007; Ground-Faulting Protection on Construction Sites - 1987.)

5.8 Fire Protection

All gasoline and diesel-driven engines requiring refueling must be shut down and allowed to cool before filling.

Smoking is not allowed during any operations within the work area in which petroleum products or solvents in free-floating, dissolved or vapor forms, or other flammable liquids may be present.

No open flame or spark is allowed in any area containing petroleum products or other flammable liquids. Only approved containers will be used to transport and store flammable liquids.

5.9 General Health

Medicine and alcohol can increase the effects of exposure to toxic chemicals. Unless specifically approved by a qualified physician, prescription drugs should not be taken by personnel assigned to operations where the potential for absorption, inhalation, or ingestion of toxic substances exists.

Drinking and driving is prohibited at any time. Driving at excessive speeds is always prohibited.

Skin abrasions must be thoroughly protected to prevent chemicals from penetrating the abrasion. It is recommended that contact lenses not be worn by persons working on the site.

6.0 EMPLOYEE TRAINING

All field personnel with the potential for hazardous exposures are required to participate in an initial minimum of 40 hours of training to recognize, evaluate, and control site hazards, plus three days of supervised field-training. Project manager level and above also participate in an additional eight-hour supervisory training course. Following the initial training, field personnel are required to take part in an annual refresher training session. This may include specific details on the following:

- regulatory requirements;
- confined space entry;
- respiratory protection;
- hazard communication;
- decontamination procedures;
- incident command system;
- air monitoring;
- toxicology; and
- fire technology.

7.0 MEDICAL MONITORING PROGRAM

Field personnel are required to have annual medical evaluations.

Additional re-evaluation will be considered in the event of chemical over-exposure while working on this site. The chemicals typical of this site can affect specific organ systems producing characteristic health effects. The medical evaluation would, therefore, focus on the liver, kidney, nervous system, blood systems, and skin and lung function. Laboratory testing will include complete blood count, and applicable kidney and liver function tests. Other tests include skin examination.

8.0 DOCUMENTATION

8.1 Site Safety Plan Agreement

Field personnel have the authority to stop work performed by subcontractors at this site if any work is not performed in accordance with the requirements of this Site Safety Plan.

All project personnel and subcontractor personnel are required to sign the following agreement prior to conducting work at the site.

A. I have read and fully understand the Site Safety Plan and my individual responsibilities.

B. I agree to abide by the provisions of the Site Safety Plan.

Name	Company	Date	Signature
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

8.2 Site Safety Plan Amendment Sheet

Project Name: _____

Project Number: _____

Location: _____

Changes in field activities or hazards:

Proposed Amendment:

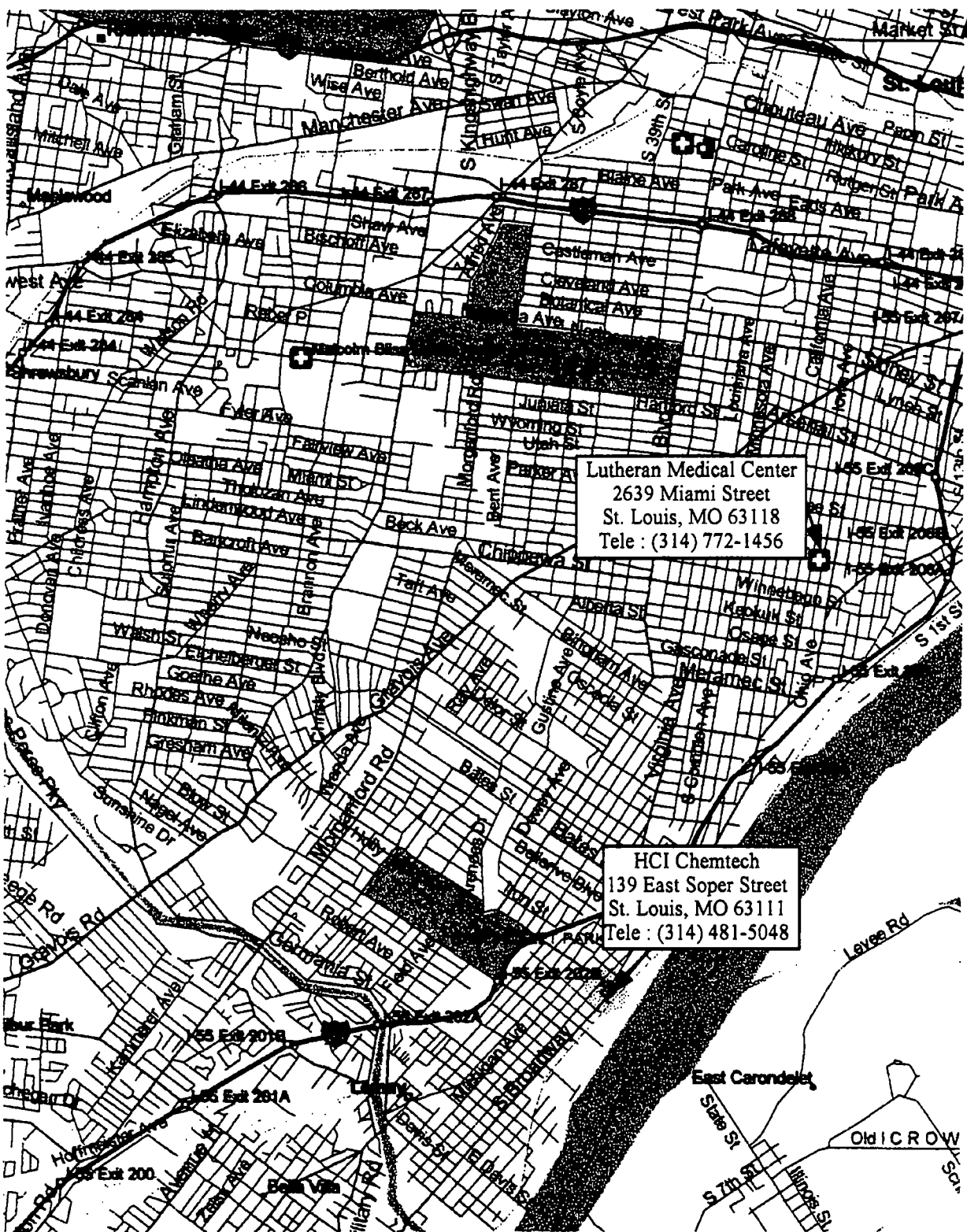
Proposed By: _____ Date: _____

Approved By: _____ Date: _____
Project Manager

Health & Safety Manager Date: _____

Amendment Effective Date: _____

NORTH



Location of Medical Facility

Scale

1.0 inch = 0.8 mile

HCI Chemtech Distribution, Inc.,
139 East Soper Street
St. Louis, Missouri 63111

*C. Johnson
Environmental*

APPENDIX A
(MSDS to be Included in Final Copy of Report)

**DRAFT
REMEDIAL INVESTIGATION
AND REMOVAL ACTION WORKPLAN**

VOLUME V

STANDARD OPERATING PROCEDURES

**FOR
HCI CHEMTECH DISTRIBUTION
139 East Soper Street
St. Louis, Missouri 63111**

Prepared for:

**HCI-Chemtech Distribution Inc.,
424 S. Woods Mill Road, Suite 325
Chesterfield, Missouri 63017**

Prepared by:

**C. Johnson Environmental
57 Amberwood Court
Moraga, California 94556**

June 1999

PROFESSIONAL CERTIFICATION

The Remedial Investigation and Interim Removal Action Workplan, the Quality Assurance Project Plan, the Sampling and Analysis Plan, the Standard Operating Procedures, and the Health and Safety Plan prepared for the HCI-Chemtech Distribution, Inc. site in St. Louis, Missouri were prepared under the direct supervision of Clarence Johnson, a Registered Geologist in the State of Missouri.



Clarence Johnson
R.G. 1006



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SOP-013	Sampling of Ground Water from Monitoring and Extraction Wells
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SOP-020	Field Instrument: Photoionization Detector (PID) Calibration and Operation
SOP-024	Field Instrument: Calibration and Operation of Water Sampling Field Instruments
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Distribution List:

Mr. Bryant K. Burnett	U.S. EPA
Ms. Julie Warren	Missouri DNR
Mr. Jeff Simko	HCI USA Distribution Companies, Inc.
Mr. Blake Tucker	HCI-Chemtech Distribution, Inc.
Mr. Clarence Johnson	C. Johnson Environmental
Mr. Michael Sellens, RG	C. Johnson Environmental
Laboratory Manager	Environmetrics, Inc. (Subcontractor Laboratory)
Laboratory Manager	Air Toxics, Ltd. (Subcontractor Laboratory)

STANDARD OPERATING PROCEDURE

SOP No: -004

Title: Drilling Operations, Well Installation, Completion, and Borehole Abandonment
Procedures

Rev: No. 2

Effective Date: February 1999

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures and equipment for drilling operations that occur to install soil borings and monitoring wells. Drilling operations also allow for the collection of subsurface soil, soil gas, and groundwater samples and the installation of groundwater and soil vapor monitoring and extraction wells and piezometers.

2.0 APPLICABILITY

This SOP is intended for personnel who plan or participate in drilling operations or tasks associated with remedial investigations (RIs). The activities addressed by this SOP and the appropriate reference are provided in the following Drilling Activity Reference Table.

3.0 TERMS AND DEFINITIONS

Specific terms and/or definitions are provided as needed in the tables.

4.0 EQUIPMENT AND PROCEDURES

This SOP contains specific details about the procedures and equipment necessary to conduct drilling operations. The project workplan or Sampling and Analysis Plan (SAP) covers the specific type of environmental investigation being conducted and the purpose and types of drilling operations.

4.1 Equipment

Drilling operations may be conducted with manual (hand) augers, hand-held power augers, or trailer- or truck-mounted diesel-powered drilling equipment. In most cases, boring and monitoring well installation is performed with a hollow-stem auger (HSA) drilling technique. If the HSA method is not adequate for the required borehole installation, a rotary drilling method should be used. Air, water, or mud rotary drilling methods are selected on the basis of advantages and disadvantages that apply to a specific location or program. See Table 4-1. Regardless of the drilling method, the downhole drilling equipment selected will ensure a borehole diameter with at least a two-inch annular clearance for all monitoring wells.

The selection of drilling equipment must balance speed and costs relative to the type of samples or data needed. Requirements of continuous soil or geophysical sampling to 100 feet or more below ground surface (bgs) are limiting factors. The need or option to construct a monitoring well, extraction well, or piezometer in a boring also limit the choices for drilling methods. No single drilling method can meet all data needs. The selection of drilling and sampling equipment must be based on the data quality objectives (DQOs) of the program.

4.2 Procedures

The following categories of procedures apply to the various tasks associated with drilling activities. These tasks include mobilization, sample collection, logging, borehole abandonment, well and piezometer construction, decontamination and demobilization, and the associated forms/data sheets required. The procedures are provided in a table format to facilitate use. The supplier conducting the field operations may subcontract specific activities or tasks; however, these procedures or approved variations are to be followed on all subsurface drilling programs.

4.2.1 Planning and Mobilization

This task is subdivided into planning procedures and field mobilization procedures, and outlined in the QAPP.

Before leaving the office to begin field activities, field planning personnel will read Table 4-2, Planning Procedure. Before the start of site operations, field personnel must be familiar with Table 4-3 Mobilization Procedures.

4.2.2 Sample Collection Procedures

The sample collection procedures are described in the QAPP. These procedures identify the sample collection task, define who is responsible for the task, and provide the reference SOP or define the criteria to fulfill task requirements. See Table 4-4.

4.2.3 Drilling and Sampling Logging Procedures

The drilling and sample logging procedures (Tables 4-5 and 4-6) are intended to promote clarity and uniformity in logging techniques. These procedures identify the task and define the criteria to fulfill task requirements. The rig geologist is responsible for fulfilling tasks identified in this section. All logging activities are to be overseen and supervised by a registered geologist.

4.2.4 Borehole Abandonment Procedures

Once drilling activities have ceased, all boreholes are completed either as monitoring or extraction wells, piezometers, or are abandoned. Abandonment is conducted in accordance with all federal, state, and local regulations. For borings drilled with truck-mounted, diesel-powered equipment, the operators must have equipment for mixing and emplacing grout that satisfies

regulations and is in accordance with these procedures. The details for borehole abandonment are provided in Table 4-7.

4.2.5 Well and Piezometer Construction

Subsurface borings may be completed as monitoring or extraction wells or piezometers. The decision to construct a well or piezometer may be made in the field on the basis of borehole conversion processes explained in the SAP or workplan. Construction materials are outlined in Table 4-8, with installation the process presented in Table 4-9. A typical monitoring well construction is shown in Figure 4-1.

4.2.6 Drilling Equipment Decontamination

The QAPP identifies the types of equipment to be decontaminated, defines the frequency of decontamination, and describes the technique to complete decontamination. Decontamination procedures are presented in Table 4-10.

4.2.7 Waste Management Procedures

Waste management procedures are outlined in Table 4-11, where the waste management tasks and responsible parties are identified, and appropriate response actions are provided. This section describes the tasks associated with drill cuttings, drill fluids, ground water, contaminated and uncontaminated trash, transportation, and final waste disposal.

4.2.8 Demobilization

Once the drilling, sampling, or well construction is complete, all drilling equipment must be decontaminated prior to leaving the site.

5.0 REFERENCES

EPA, 1995. *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents.*

6.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE

SOP No: -009

Title: Geoprobe (Direct-Push) Soil Sampling

Effective Date: March 1999

1.0 PURPOSE

The objective of this procedure is to collect a soil sample at depth and recover it for visual inspection and/or chemical analysis using a small diameter boring with a hydraulic direct push drilling rig.

2.0 APPLICABILITY

This SOP is intended for field personnel involved in soil boring and the collection of soil samples using a Geoprobe or similar technology.

3.0 TERMS AND DEFINITIONS

Geoprobe:	A vehicle-mounted hydraulically powered soil probing machine that uses static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.
Soil Sampler:	A 48-inch long x 2.0-inch diameter soil sampler capable of recovering a sample that measures up to 1302-ml in volume, as a 45-inch x 1.5-inch core contained inside a removable liner. The sampler may be used for open-tube as well as a closed piston sampler.
Liner:	A 46-inch long x 1.75 inch diameter removable/replaceable, thin-walled tube inserted inside the sampler tube for containing and storing soil samples. Liner materials include stainless steel, Teflon, and clear plastic (PETG).

4.0 EQUIPMENT AND PROCEDURES

In this procedure, the assembled sampler is connected to the leading end of a Geoprobe probe rod and driven into the subsurface using a Geoprobe machine. Additional probe rods are connected in succession to advance the sampler to depth. The core sampler may be used as either an open-tube or closed-piston sampler.

The simplest and most common use of the core sampler is an open-tube sampler. In this method coring starts at the ground surface with an open-ended sampler. From the ground

surface, the core sampler is advanced 45 inches and retrieved from the hole with the first soil core. In stable soils, the open-tube sampler is inserted back down the same hole to obtain the next core.

In unstable soils that tend to collapse into the core hole, the core sampler can be equipped with a closed-piston point assembly. This assembly locks into the cutting shot and prevents soil from entering the sampler as it advances in the existing hole.

A closed-piston sampler is not designed to be driven through undisturbed soil. Soil is first removed to the sampling depth with an open-tube sampler, or a pilot hole. A closed-piston tip is then installed and the sampler is inserted or driven back: down the same hole. When the leading end of the sampler reaches the top of the next sampling interval, the piston tip is unlocked using extension rods inserted down the inside of the probe rods.

Once the piston tip is released, the sampler is driven another 45 inches. Soil entering the sampler pushes the piston assembly to the top of the sample liner where it is retrieved upon removal of the soil core and liner.

4.1 Equipment

The following equipment is required to recover soil core samples using the Geoprobe sampler and driving system.

Sampler Parts

- Drive Head
- Sampler tube
- Cutting Shoe
- Piston Bolt
- Piston Washer
- Locking Ring Assembly
- Piston Point Assembly
- Piston Release Rod
- Core Catcher (optional)
- Spacer Ring

Geoprobe Tools

- Probe Rod (48", 36", 24", or 12")
- Drive Cap
- Pull Cap
- Extension Rod
- Extension Rod Coupler
- Extension Rod Handle

5.0 OPERATION

5.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements. The samplers should be decontaminated as described in Table 4-10, smaller equipment, of SOP-004. A clean, new liner is recommended for each use. Parts should also be inspected for wear or damage at this time.

5.2 Open-Tube Sampler Assembly

- 1a. **With Core Catcher.** Place the open end of a core catcher over the end of the cutting shoe. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.
- 1b. **Without Core Catcher.** Push the base of a spacer ring onto the threaded end of a cutting shoe until it snaps into place.
2. Thread the cutting shoe into one end of a sampler tube. Tighten until the cutting shoe is completely threaded into the sampler.
3. Insert the appropriate liner into the sampler tube.
4. Connect drive head to the top of the sampler tube. Tighten the cutting shoe using a wrench.

5.3 Closed-Piston Sampler Assembly

1. Install an O-ring in the machined groove on the piston point.
2. Place piston washer on the piston bolt radius side away from the bolt head.
3. Assemble the piston assembly according to the Geoprobe instructions.
4. Slide the assembled point into a cutting shoe. The point assembly should be placed so that one-half of the set screw protrudes from under the lower cutting edge of the cutting shoe.
5. Tighten the piston bolt using a wrench.
- 6a. **With Core Catcher.** Place the open end of a core catcher over the threaded end of a cutting shoe. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

- 6b. **Without Core Catcher.** Push the base of a spacer ring onto the threaded end of a cutting shoe until it snaps into place.
7. Thread the cutting shoe into one end of a sampler tube. Tighten until the cutting shoe is completely threaded into the sampler.
8. Insert the appropriate liner into the sampler tube.
9. Connect a drive head to the top of the sampler tube. Tightly secure the cutting shoe with a wrench.

5.4 Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sands, or rubble. Pre-probing can prevent unnecessary wear on the sampling tools. A pre-probe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval.

5.5 Open-Tube Sampling

For open-tube sampling, the soil must be removed from above the desired maximum core depth. This is accomplished by driving a core sampler 48-inches, the length of one sampler tube, into the soil from the ground surface. The first soil core is retrieved and the sampler is driven down the same hole to remove the next 48-inch core. This cycle is repeated until the desired sampling depth is reached.

The cutting shoe is tapered to minimize the amount of soil scraped from the walls when inserting the sampler down an existing hole. When sampling non-cohesive soils, however, the hole may collapse as the sampler is retrieved. This collapsed soil enters the sampler as it is driven back down the hole for the next soil core, resulting in a non-representative sample. The user may elect to use the closed-piston core sampler under such conditions.

1. Use an assembled open-tube sampler as described in section 4.3. Attach a drive cap to the sampler head.
2. Drive the assembly into the subsurface until the drive head of the sample tube is just above the ground surface.
3. To sample continuous sampling intervals, push a sampler down the previously opened hole until the top of the next sampling interval is reached. Drive the probe string another 48-inches to fill the sampler with soil. An open-tube sampler may be used for consecutive sampling or if soil slough is expected, a closed-piston sampler is available.

5.6 Closed-Piston Sampling

1. Using an assembled closed-piston sampler. Attach a drive cap to the sampler drive head.
2. Place the sampler point in the previously opened hole. Drive the sampler to the desired sampling interval.
3. Move the probe unit away from the probe rods to allow for room to work.
4. Remove the drive cap and insert a piston release rod down the inside of the probe rods; use extension rods as needed.
5. Attach an extension rod handle to the top of the extension rod and slowly rotate clockwise. The release rod will drop into the groove in the piston point. Rotate the handle clockwise approximately four revolutions. The drive point assembly is now released.
6. Remove the release rod and extension rods.
7. Add a probe rod, if needed, attach a drive cap, reposition the probe unit. Drive the sampler another 48 inches to fill the liner with soil.

5.7 Sampler Retrieval

1. Attach a pull cap to the top probe rod. Close the hammer latch over the pull cap and pull the tool string up one rod length actuating the probe controls.
2. Remove rod and repeat Step 1 until the sampler drive head is just above the ground.
3. Put the drive cap on the sampler drive head. Pull the sampler out of the ground by using the probe unit.

5.8 Soil Core Recovery

The soil sample is easily removed from the core sampler by unscrewing the cutting shoe and pulling out the liner. A few sharp taps on the cutting shoe will often sufficiently loosen the threads to allow removal by hand. If needed, a wrench may be used to unscrew the cutting shoe. With the cutting shoe removed simply pull the liner and soil core from the sampler tube.

If the closed-piston sampler is used, the piston assembly is now retrieved from the end of the liner. Secure the soil sample by placing a vinyl end cap on each end of the liner. Undisturbed soil samples can be obtained from Teflon and PETG liners by cutting the liner and

capping the ends. Samples may also be collected by clamping one end of the liner and making a longitudinal cut, exposing the soil core. The sample interval is selected and packed tightly in the appropriate sample container with no void spaces. The remaining soil is used for field descriptions and screening.

6.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE

SOP No: -010

Title: Groundwater Sampling Using Geoprobe (Direct-Push) Technology

Effective Date: March 1999

1.0 PURPOSE

The purpose of this procedure is to drive a sealed stainless steel or PVC screen to depth, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point Ground Water Sampler enables the operator to conduct grouting that meets American Society for Testing and Materials (ASTM) Method D 5299-92 for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 APPLICABILITY

This SOP is intended for field personnel involved in soil boring and the collection of groundwater samples using a Geoprobe or similar technology.

3.0 TERMS AND DEFINITIONS

Geoprobe:	A vehicle-mounted hydraulically powered soil probing machine that uses static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.
Screened Point Ground Water Sampler:	The assembled screen point sampler is 1.5-inch OD x 52-inch overall length. This sampler features a 41-inch stainless steel or PVC screen. The device is also useful for measurement of piezometric levels.
Casing Puller:	An assembly which makes it possible to retract the sampler string with extension rods protruding from the top of the probe rods.

4.0 EQUIPMENT AND PROCEDURES

In this procedure, the assembled screen point sampler threads onto the leading end of a Geoprobe probe rod and is driven into the subsurface using a Geoprobe machine. Additional probe rods are connected in succession and advance the sampler to depth. While the screen point sampler is being driven to the desired sampling depth, it is kept sealed by O-ring connections placed at critical locations on the assembly.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the samples screen. The tool string is then retracted approximately 44 inches while the screen is held in place with the extension rods. As the tool string is retracted, the expendable point is released from the sampler sheath. An O-ring on the screen head maintains the seal at the top of the screen. As a result any liquid entering the sampler during screen deployment must first pass through the screen. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

In common practice, groundwater samples are recovered by pumping or bailing of water collected in the sampler screen. The standard slot size of the screen of this sampler is 0.004-inches and 41 inches in length. This sampler will allow the user to collect representative samples in a short time period due to its large surface area.

A removable plug located in the bottom of the groundwater screen, allows the user to grout as the sampler is extracted. This ensures a proper abandonment of the probe hole.

4.1 Equipment

Equipment required to successfully recover water samples using the screen point groundwater sampler is listed below.

Screen Point Sampler Parts

- O-ring Service Kit
- Sampler Sheath
- Drive Head
- Stainless Steel/PVC Screen
- Screen Push Adapter
- Grout: Plug Push Adapter
- Grout Plugs, Teflon/PVC
- Expendable Drive Points

Geoprobe Tools

- Probe Rod (48", 36", 24", or 12")
- Drive Cap
- Pull Cap
- Extension Rod
- Extension Rod Coupler
- Extension Rod Handle
- Extension Rod Jig

Optional

Tubing Bottom Check Valve
Check Balls for Check Valve
Polyethylene Tubing, 1/4-inch ID

5.0 OPERATIONS

5.1 Basic Operation

The screen point groundwater sampler uses a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a water-tight sheath.

Once the sampling depth is reached, extension rods equipped with a screen push adapter are inserted down the inside of the probe rods. The probe rods attached to the sampler are retracted with the extension rods in place, approximately 44 inches to allow the sampler screen to be pushed out into the formation. At this point the sampler is ready to collect a groundwater sample. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

5.2 Decontamination and Preparation of Parts

In order to assemble the water sampler properly and to take representative water samples all parts need to be cleaned thoroughly and if necessary, individually decontaminated prior to their use. For each test run, fresh decontaminated sampler parts and O-rings should be used.

All parts should be washed with soapy water. All soil adhering to the parts should be removed by brushing or pressure washing. Finally, all parts should be rinsed with clean contaminant-free water and allowed to dry before they are assembled.

Check all O-rings in the sampler assembly for damage and/or wear. All worn O-rings should be replaced. It is more efficient and cost effective to change O-rings rather than collecting a non-representative sample or invalid data.

5.3 Assembly

1. Install an O-ring on an expendable drive point. Firmly seat the expendable point in the necked end of the sampler sheath.
2. Place a grout plug (PVC or Teflon) in the lower end of either a wound-wire stainless steel or PVC screen. When using a stainless steel screen, install an O-ring in the groove on the upper end of the screen. Slide the screen inside of the

sampler sheath with the grout plug towards the bottom. Ensure that the expendable point was not dislodged by the placement of the screen.

3. Install a bottom O-ring on a drive head. Thread the drive head onto the sampler sheath. Attach a drive cap to the drive head.
4. Sampler assembly is complete.

5.4 Probing

1. Drive the screen point groundwater sampler to depth. Use probe rods as needed. Approximately 12 inches of the last probe must extend above the ground surface to allow attachment of the puller assembly.
2. Remove the drive cap and retract the probe derrick away from the tool string.

5.5 Screen Deployment

Once the screen point groundwater sampler has been driven to the base of the desired sampling interval, the probe rods are retracted a distance of 44 inches and the screen is pushed out into the formation. The following procedures are employed to deploy the screen:

1. Thread the screen push adapter on an extension rod. Lower the extension rod inside the probe rods. Add extension rods, as needed, until the adapter contacts the bottom of the screen.
2. Install the casing pull bracket on the probe hammer.
3. Reposition the probe derrick and hammer assembly such that the casing pull bracket is below the top of the probe rod.
4. Place the casing pull plate over the probe rod and install an open-bore bull cap.
5. Ensure that at least 48 inches of extension rod protrudes from the probe rod. Thread an extension rod handle on the top extension.
6. Retract probe rods and sampler sheath while physically holding the screen in place with the extension rods. Raise the hammer and pull the bracket assembly approximately 44 inches. At this point the screen head will contact the necked portion of the sampler sheath and the extension rods will rise with the probe rods. The screen is now deployed.

7. Lower the hammer assembly and retract the probe derrick. Remove the top extension rod and handle, pull cap, casing pull plate, and top probe rod. Finally, extract all extension rods.
8. Groundwater samples can now be collected.

5.6 Sampling, General Considerations

There are two methods for obtaining a sample from the screen point sampler. Groundwater samples can be obtained by bailing or pumping directly from the bore of the probe rods inside the screen point sampler. Alternately, a tubing system may be inserted within the deployed screen and samples pumped to the surface using either a peristaltic pump or other means of vacuum lift. Samples should be collected using the techniques described in Section 4.2.2 of SOP-013.

5.7 Abandonment Grouting

The screen point sampler can meet ASTM D 5299-92 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of the screen. Grout is then pumped into the open hole as the sampler is withdrawn. The following procedure can be used as the proper abandonment of a probe hole.

1. Position the casing pull bracket and pull plate over the tool string and place a split pull cap on the top probe rod. Raise the tool string approximately 4 to 6 inches to allow for removal of grout plug. Remove the pull cap.
2. Thread the grout plug adapter onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the grout plug adapter contacts the bottom of the screen. Apply pressure to the extension rods to release the grout plug. When the grout plug is pushed from the screen, remove all extension rods.
3. Connect a grout nozzle to polyethylene tubing and insert into the probe rods and down through the bottom of the screen. Once the grout nozzle is set through the bottom of the screen, pull gently on the tubing to ensure that it is locked in place.
4. Attach a split cap to the top probe rod, position the polyethylene tubing in the pull cap slot taking care not to pinch or bind the tubing. Operate the grout pump while pulling the probe rod string. Remove the split pull cap and unscrew the probe rod. Slide the rod over the tubing and place it on the ground near the end of the tubing making sure not to bend or kink the tubing. Repeat this step until the sampler is retrieved.

5. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

6.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE

SOP No: -013

Title: Sampling of Ground Water from Monitoring and Extraction Wells

Effective Date: February 1999

1.0 PURPOSE

This SOP establishes procedures for collecting groundwater samples from monitoring and extraction wells. Decontamination procedures for sampling equipment are also described.

These guidelines will help ensure quality and consistency in sample collection procedures. These procedures will be followed in conjunction with other documentation and recordkeeping procedures.

2.0 APPLICABILITY

This SOP is intended for personnel who participate in groundwater sampling, data review, and reporting activities.

3.0 TERMS AND DEFINITIONS

DIS - Discrete interval sampler.

VOC - Volatile organic compound(s).

4.0 EQUIPMENT AND PROCEDURES

Groundwater sampling is performed to obtain samples representative of the ground water surrounding the well screen. These samples ensure that the analytical results reflect the quality of the ground water at a geographic location and a monitoring zone as accurately as possible.

4.1 Equipment

Sampling of wells will be performed using the following sampling system:

Bailer and Submersible Pump - An electric submersible pump and/or a Teflon or disposable bailer are used to purge water and collect samples at wells. The pump is typically used to purge the well, while the bailer is used for sample collection. A flow control valve attachment on the bailer transfers the sample to the sample bottles; this minimizes sample agitation that could release volatile organic compounds (VOCs). Shallow wells with a small water column or wells that produce insufficient water to allow the use of a pump are purged with a bailer.

4.2 Procedures

General pre- and post-sampling procedures (e.g., planning, equipment decontamination) are discussed in Section 4.2.1. The bailer/submersible pump sampling procedures are described in Section 4.2.2. Procedures generally adhere to the United States Environmental Protection Agency's (EPA) Compendium of Superfund Field Operations (1987).

4.2.1 Sample Planning and Equipment Decontamination Procedures

For bailers, submersible pumps, water level meters, discharge hoses (and any other equipment that comes into direct contact with samplers):

1. Scrub with water and laboratory grade, phosphate-free detergent.
2. Rinse with potable water (for discharge hoses used with the submersible pumps, only the first three steps are required).
3. Rinse with deionized water.
4. If necessary rinse with reagent grade methanol hexane (if the temperature is greater than 45 degrees Fahrenheit (F), use cyclohexane to reduce health and safety concerns associated with hexane exposure).
5. Rinse again with water after solvents have dried.
6. Small pieces of equipment used for organic samples are stored and transported on decontaminated aluminum trays.

Groundwater samples are collected in a prearranged priority so that collection and handling of samples occurs as efficiently as possible. Although the actual sample collection protocol will depend on the analytes of interest, general sample collection procedures must be consistent. Prior to using the bailer or collecting a sample from the discharge line, wear new, clean disposable gloves to avoid cross contamination. Samples for volatile constituents are collected first to avoid loss of volatiles to the air.

During all sampling activities, the support equipment is positioned so any potential volatile organic sources, such as vehicles; gasoline-driven generators; and fuel and chemical storage tanks, are downwind. Contamination caused by entrainment of volatile contaminants in the sample is thus avoided. Any potential VOC sources that are unavoidable are noted on the well purging log.

Well purging is an integral step in recovering samples representative of the quality of ground water flowing through the monitoring zone. Each monitoring well is purged immediately prior to sample collection, ensuring the sample is fresh monitoring zone ground water rather than

stagnant water that has been standing in the well casing. Specific purging procedures are presented in Section 4.2.2.

4.2.2 Sampling Procedures for the Bailer/Submersible Pump System

4.2.2.1 Well Purging Procedures

Prior to purging, calculate the minimum purge volume that must be collected (i.e., three wetted casing volumes) as follows:

$$\text{Minimum Purge Volume (gallons)} = 3 \times V$$

where:

$$V = 3.14 r^2 L \times 7.48 \text{ gallons/ft}^3$$

V = One wetted casing volume (gallons);

r = Inside radius of casing (feet); and

L = Height of water column in well (feet).

During purging, position the bailer or pump in the middle of the screened interval to ensure that standing water is removed and fresh formation water is drawn into the well. Purged ground water is collected in either 55-gallon drums or suitable holding tanks. Following receipt of the analytical results the water may be discharged into either the local sanitary sewer system or transported off site for disposal at a licensed treatment facility.

In low-yield wells that may be purged dry before three wetted casing volumes have been removed, the sample shall be collected when enough water has reentered the well to obtain the volume of water needed for all sample containers. The time when the well was purged dry is recorded on the groundwater field sheets, as well as the volume of water removed prior to sampling.

A five-gallon bucket (or similar container of known capacity) is used to measure the amount of water removed from the well during purging. Elapsed time is noted as the container is filled, thereby, allowing the calculation of the discharge rate. Record the total amount of water purged from each well on the field sheets.

Sampling of wells is performed using a decontaminated Teflon or dedicated disposable bailer. A new monofilament line or braided stainless steel line is securely attached to the bailer. The bailer is lowered slowly into the well, taking care to cause as little disturbance as possible to the water surface. Water is collected from the middle of the screened interval of the well. As the bailer is lowered and raised, take care to keep the line clean and off the ground surface. To minimize this problem, the monofilament line can be directed into a clean bucket or similar container as the bailer is being raised. The bailer is filled and emptied twice to condition it

before collecting samples. A flow control valve is used to transfer water from the bailer into the sample containers.

Samples are collected from bailers using the flow control valve by attaching the valve to the bailer after purging is completed and slowly opening it until a smooth, steady flow is obtained. The sample bottle is then placed directly under the bailer and attached, so a minimum free-fall distance occurs during sample collection. This will minimize agitation or aeration of samples that may cause VOC loss.

The VOC sample bottles must be filled slowly to prevent the entrapment of air bubbles; splashing or agitating the water is to be avoided. The bottle is tilted completely such that a reverse meniscus forms. The cap is screwed on and the bottle inverted, tapped firmly, and checked for the presence of air bubbles. If a bubble is present, the sample is discarded and a new sample collected; preservatives are added if appropriate. If a bubble appears a second time in the same bottle, discard that bottle and prepare a new one. Accurate VOC analytical results may be compromised if any air is trapped in the sample container.

STANDARD OPERATING PROCEDURE

SOP No: -015

Title: Collection of Sediment Samples in Ponds, Surface Impoundments, and Streambeds

Effective Date: October 1998

1.0 PURPOSE

This standard operating procedure (SOP) establishes procedures for the collection of sediment samples (wet and dry) from ponds, surface impoundments, and streambeds. Use of dredges and PVC tubes for collecting wet sediment samples is discussed; dry sediment samples are collected using surface soil sampling procedures (refer to SOP-016, Soil Sampling). These guidelines will help ensure quality and consistency in sample collection procedures. These procedures will be followed in conjunction with other documentation and recordkeeping procedures described in the quality assurance project plan (QAPP).

2.0 APPLICABILITY

This SOP is intended for personnel who participate in sampling, data review, and reporting activities associated with the RI project.

3.0 TERMS AND DEFINITIONS

Surface Impoundment: A water reservoir; a basin for collection and storage of run-off.

PVC-Polyvinyl chloride

4.0 EQUIPMENT AND PROCEDURES

4.1 Equipment

Dredge - A clamshell-type scoop device designed to be lowered to the bottom of a pond, surface impoundment, or stream for collecting sediment samples. The three most common types of dredges are the Peterson, the Ponar, and the Eckman dredges:

- The Peterson dredge is designed for sampling sediments from a rocky bottom;
- The Ponar dredge is a modified version of the Peterson dredge; it generates less turbulence (i.e., disruption of sediment layers) than the Peterson dredge during sample collection; and
- The Eckman dredge is designed for use on very soft, muddy sediment layers.

The dredges weigh approximately 30 to 40 pounds; Petersen and Ponar dredges must be used with a winch and cable system.

Other types of sediment sampling devices include a coring-type sampler (PVC or stainless steel tube) and a scoop (or spoon); support equipment includes:

- A row boat from which to collect the samples;
- Nylon rope or cord from which to suspend the dredge and line up sampling locations (i.e., across the ponds);
- Winch and cable system for Petersen or Ponar dredges;
- A compass and measuring wheel with which to locate sampling points;
- Field meters to measure parameters specified in the FSP;
- Metal or wooden stakes for suspending the sampling grid lines;
- A stainless steel mixing bowl, spoons and a tray;
- Labeled sample jars and preservatives;
- Tape measure;
- Hammer (for use with the PVC tube);
- Peristaltic pump (for use with the PVC tube);
- Vacuum pump (battery-powered);
- Decontamination supplies; and
- Cooler with ice.

4.2 Decontamination

All field and sampling equipment that may come in contact with samples must be decontaminated after each use. All decontamination liquids (water, solids) will be collected in appropriate containers and are contained and disposed as appropriate after the results of the analyses have been obtained. All wastes will be stored and transported in approved containers only.

Downhole and surface sampling equipment including split spoon samplers, sampling sleeves, groundwater sampling hoses, and hand augers are decontaminated between uses by the following procedures:

1. Scrub with water and laboratory-grade phosphate-free detergent (e.g., Alconox) to loosen any dirt or oily material (hose is not scrubbed).
2. Clean using a steam cleaner or high-pressure hot water until all visible traces of material have been removed.
3. Rinse with potable and deionized (DI) water.
4. If applicable, rinse with reagent-grade methanol and hexane or cyclohexane if any residue remains.
5. Rinse again with DI water after solvents have dried to remove any residue

6. All decontaminated equipment is stored and transported in clean, decontaminated containers.

4.3 Procedures

It is expected that sediment sampling can be performed using one of the following four procedures:

- A dredge;
- A core-type tube sampler;
- A scoop; or
- Dry sediment sampling (refer to the surface soil sampling procedures in Soil Sampling SOP).

4.3.1 Use of Dredges for Collecting Sediment Samples from Ponds, Impoundments, or Streams

The three types of dredges are designed and operated similarly. The sediment sampling in water bodies more than approximately three feet deep will be conducted using the Ponar dredge; the other dredges may be used when conditions allow. The dredge sampling procedure is described below:

1. Sampling locations are indicated in the sampling and analysis plan (SAP).
2. Locate sediment sampling points by measuring and marking grid points along the sides of the pond (or stream) using a compass, measuring wheel, and labeled stakes. A nylon rope may be strung across the pond in both directions and secured to stakes on each side of the pond, creating a grid of sampling points (i.e., the intersections of the lines).
3. Load the sampling equipment (i.e., dredge, stainless steel mixing bowl and spoon, sample jars) into the boat and position the boat at the first sampling point.
4. Attach the dredge to the necessary length of sample line (e.g., a nylon rope or winch cable); clean the dredge before use (refer to the cleaning procedure described in the QAPP) to minimize the potential for sample contamination.
5. Tie the free end of the sample line to a fixed support on the boat to prevent accidental loss of the sampler.
6. Open the sampler jaws until latched, and slowly lower the dredge to the bottom of the pond to avoid disturbing lighter bottom sediments.

7. When the dredge is resting on the bottom, mark the water level on the rope so that distance to the sediment layer can be measured.
8. Ease the sample line tension (i.e., allow to slack about an inch) to release catch mechanism on the jaws.
9. Trip the lever system to close jaws, and slowly raise to the surface.
10. Place the dredge onto a stainless steel tray and open the jaws to release sediments (approximately 0.25 to 0.5 cubic feet of sediment); remove the dredge from the tray.
11. Mix the sediment in a stainless steel bowl and transfer it to sample bottles using a stainless steel spoon.
12. Measure the distance from the bottom of the dredge to the water level mark on the rope (refer to Step 7) to determine the distance to the sediment; record the distance on the data sheet.
13. Complete the necessary paperwork (e.g., sample description, samplers, date and time, chain-of-custody form, etc.), label and store bottles, and decontaminate equipment as required in the QAPP.
14. Position the boat at the next sampling point and repeat Steps 4 through 13.

4.3.2 Use of a Core-Type Tube Sampler for Collecting Sediment Samples from Ponds, Impoundments, or Streams

A PVC or stainless steel tube may be used to collect sediment samples from a pond or streambed where the water is shallow enough to allow its use.

1. One end of the tube is gently placed over the sediment layer at the desired sampling point. If the sampler wades to the sampling point (i.e., in a stream or shallow pond), the sampler must take precautions to ensure that the sediment layer is not disturbed prior to sampling. In a streambed, for example, the sampler should position his feet downstream of the sampling point.
2. The tube is pushed into the sediment layer to the desired sampling depth; a hammer may be used to drive the tube to depth if necessary.
3. To remove the sample, the sampler places his hand over the open end of the tube to create an air-tight seal. The tube is then removed from the sediment layer. As an alternative, a stopper with a small tube installed in it may be inserted in the end of the sampling tube. A battery-powered vacuum pump is then used to

remove the liquid from above the sediment in the tube, so that the sediment sample remains in the tube when the sampler is withdrawn.

4. The "plug" of sample material is then removed from the tube and either placed in a sample bottle or onto a tray if a particular layer (i.e., depth) is of interest.
5. If the sediment is too fluid to remain in the tube, a hand auger barrel can be extended down through the casing to collect a sediment sample. The sediment is placed directly into the sample container or a stainless steel bowl for compositing. If necessary, a sand catcher can be used in the auger bit.
6. Complete the necessary paperwork (e.g., sample description, samplers, date and time, chain-of-custody form, etc.), label and store bottles, and decontaminate equipment as required in the QAPP.

4.3.3 Use of a Scoop for Collecting Sediment Samples from Ponds, Impoundments, or Streams

If the water is wadeable, the easiest way to collect a sediment sample is to scoop the sediment using a stainless steel spoon or scoop. This procedure reduces the potential for cross-contamination. This can be accomplished by wading into the stream and, while facing upstream (into the current), scooping the sample along the stream bottom in the upstream direction. If the stream is too deep to wade, but less than eight feet deep, a stainless steel scoop attached to a piece of conduit can be used either from the banks if the stream is narrow or from a boat.

5.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE

SOP No: -016 .

Title: Collection of Surface and Sub-Surface Soil Samples

Effective Date: February 1999

1.0 PURPOSE

This SOP establishes procedures for the collection of surface and subsurface soil samples. Procedures for collecting both discrete and composite samples for analysis of volatile, semivolatile, and nonvolatile constituents are presented. Analytical procedures for screening and off site analyses are described in the site-specific Sampling and Analysis Plan (SAP). This SOP discusses procedures for:

- Sampling borings from drilling operations; and
- Sampling surface soils and sediments in dry streambeds.

Adherence to these procedures helps ensure quality and consistency in sample collection procedures. These procedures are followed in conjunction with other documentation and recordkeeping procedures described in the site specific quality assurance project plan (QAPP).

2.0 APPLICABILITY

This SOP is intended for personnel who participate in sampling, data review, and reporting activities.

3.0 TERMS AND DEFINITIONS

Lithologic:	Relating to the physical characteristics of rock or soil, generally determined with the unaided eye, with a hand lens, or with the aid of a low-powered magnifier.
Volatile Organic Compound (VOC):	Compound usually containing less than eight carbons that has a tendency to transform into the vapor state.
Semivolatile Organic Compound (SVOC):	Compound that has some tendency to transform into the vapor state at specified temperatures. Usually these compounds range from eight to 30 carbons in composition.

Nonvolatile Compound: Compound that will not pass into a vapor state at normal ambient temperature. Also defined as compounds having a boiling point of 100 degrees Celsius (C) or less.

Native Material: Undisturbed soil or bedrock.

4.0 EQUIPMENT AND PROCEDURES

4.1 Equipment

- Hand auger.
- Hollow stem auger - Drilling method employing a hollow helical steel drill tool rotated to advance the boring and lift formation materials (cuttings) to the surface.
- Core sampler with soil sleeves - Goring device used to obtain soil samples at five-foot intervals or other designated intervals for chemical analysis, visual observation, lithologic characterization, or soil vapor screening; allows for the collection of relatively undisturbed samples. The sampler is split lengthwise to insert and remove sleeves (commonly stainless steel or brass).
- Split spoon core sampler with soil sleeves - Same as above.
- Mud Rotary Drill - Drilling method employing a bit/drill pipe assembly rotated to advance the boring using mud pumped down through the drill pipe and out through ports or jets in the drill bit. The mud returns upward in the annular space between the hole and the drill pipe carrying the cuttings.
- Air Rotary Drill - Drilling method employing a bit/rotating drill pipe assembly within a nonrotating outer drive casing. The bit is advanced using air forced under pressure downward; the outer casing is driven downward by repeated blows of a percussion hammer.

4.2 Procedures

Surface and near-surface soil samples can be collected using the following techniques:

- Surface scraping.
- Hand augering.
- Core sampling.

Soil sampling activities and field measurements are documented on a field data sheet.

4.2.1 Surface Scraping

Surface scraping may be used to collect soil samples from:

- Ground surface(s) including sediment in dry stream beds;
- Sidewalls and/or the bottom of trenches or excavations; and
- Scale or sediment from tanks, ponds, impoundments, or streams.

The samples are collected using the following procedure:

1. Check all equipment and sample containers to ensure that the equipment is clean and that the containers are new and have been properly prepared.
2. Label container and initiate the chain-of-custody process and sample-specific data sheet, as applicable.
3. Prepare surface for sampling by removing any vegetation, sticks, stones, etc.
4. Discrete samples:
 - a. Scrape a thin layer of soil directly into the sample container using a stainless steel spoon. This should be done as quickly and with as little disturbance as possible to minimize the loss of volatile and semivolatile organics.
 - b. Cap the container with a Teflon-lined cap and place in a cooler at four degrees C.
5. Laboratory composited samples (nonvolatile parameters only):
 - a. Collect individual samples at each location to be composited as described in Step No. 4 above.
 - b. In the laboratory, homogenize each sample designated to be included in the composite and combine an equal weight of each in the composite. Note: Prior arrangements are required for this step.
6. Field composited samples (nonvolatile parameters only):
 - a. Collect an equal amount of soil from each location to be included in the composite by scraping a thin layer of soil into separate sample jars. Empty all of the jars into a stainless steel bowl.
 - b. Homogenize the soil by thoroughly mixing with a stainless steel spoon.
 - c. Divide the homogenized soil into four equal quarters and collect the composite sample from one of the quarters.
 - d. Cap the labelled container with a Teflon-lined cap and place in a cooler with ice.
7. Complete chain-of-custody and field data sheets.
8. Decontaminate sampling equipment between each sample following the procedure described in the QAPP.

9. Document sample locations on a map (should include measurements from at least one reference point).

4.2.2 Hand Angering

A hand auger is used to collect soil samples at depths up to five feet below grade; the technique can also be used to a depth of 30 feet providing that lithologic conditions allow penetration (e.g., in loose sand). This technique is not appropriate for volatile samples because the components may volatilize during sample collection. Volatile components of subsurface soil samples should be collected using a core sampler with soil sleeves (refer to Section 4.2.3 of this SOP). The hand auger is equipped with three-inch diameter cylindrical stainless steel bits. Soil samples are collected as follows:

1. Check all equipment and sample containers to ensure that the equipment is clean and that the containers are new and have been properly prepared.
2. Label container and initiate chain-of-custody and task/sample-specific data sheet, as applicable.
3. Auger to the desired sampling depth. Soil for lithologic inspection should be placed on plastic sheeting.
4. Discrete samples:
 - a. At the desired sampling depth, collect soil in the bit and empty into a stainless steel bowl. Typically, a one-foot column of soil will be collected. However, if only a short column of soil is desired, the soil can be emptied directly into the sample container. Measurements using a field gas analyzer, i.e. organic vapor meter (OVM) are taken and recorded on field data sheets at this time if required in the SAP.
 - b. Homogenize the soil by mixing with a stainless steel spoon. Minimize mixing or eliminate when sampling for semivolatile organics.
 - c. Divide the homogenized soil into four equal quarters and collect the sample from one of the quarters. More than one quarter may be used if an additional sample is needed for all parameters.
 - d. Cap the labelled container with a Teflon-lined cap and place in a cooler with ice.
5. Backfill the hole with native material or fill the hole with cement grout if required in the SAP.
6. Laboratory composited samples (nonvolatile parameters only):
 - a. Collect individual samples at each location to be composited as described in Step No. 4 above.

- b. In the laboratory, homogenize each sample designated to be included and combine an equal weight of each in the composite. Note: Prior arrangements are required for this step.
7. Field composited samples (nonvolatile parameters only):
 - a. Collect an equal amount of soil from each location to be included in the composite.
 - If soil samples from different depths within the same auger hole are to be composited, place soil from each depth into a stainless-steel bowl.
 - If soil samples from the same depth in different auger holes are to be composited, collect soil from each location (per Step 4) and place the material in separate sample containers. Then empty all of the samples into the metal bowl after all locations have been sampled.
 - b. Homogenize the soil by thoroughly mixing with a stainless-steel spoon.
 - c. Divide the homogenized soil into four equal quarters and collect the composite sample from one of the quarters.
 - d. Cap the container with a Teflon-lined cap and place in a cooler with ice.
8. Complete the chain-of-custody form and field data sheets.
9. Decontaminate sampling equipment between each sample following the procedure described in Section 5.2.
10. Document sample locations on a map (should include measured distances from at least one reference point).

4.2.3 Core Sampler with Soil Sleeves

Core sampling with soil sleeves is used to collect soil samples at depths up to 10 feet below grade. The core sampler with slide hammer handle will collect undisturbed soil samples (i.e., uniform and non-aerated) by driving a cylindrical cup (similar to the bit of a split-spoon sampler) into the ground using a sliding, weighted handle. This method is appropriate for collecting samples for volatile and semi- or nonvolatile parameter analyses.

The core sampler is a two-inch diameter cylinder or cup that houses a series of compartments or sleeves in which the soil samples are collected. The length of the sleeves can vary from one to six inches. Sampling subsurface soil requires drilling to the desired depth with a hand auger. The soil lithology is recorded on a boring log (refer to drilling SOP-004). Soil samples are collected as follows:

1. Check all equipment and soil sleeves to ensure that the equipment, including the sleeves, has been properly cleaned. Ensure that the containers are new and have been properly prepared. Soil sleeves are cleaned prior to sampling by the following four-step process:

- a. Wash sleeves in a solution of nonphosphate detergent and potable water;
 - b. Rinse with potable water;
 - c. Rinse with deionized (DI) water; and
 - d. Bake at 160 degrees C for at least eight hours.
2. Initiate chain-of-custody forms and sample-specific data sheet, as applicable.
3. Drill to the desired sampling depth with a hand auger to penetrate hard or composited soil. Soil for lithologic inspection should be placed on plastic sheeting.
4. At the desired sampling depth, remove the auger and drive the core sampler into the ground with a sliding hammer action.
5. Remove the core sampler and open the cup. Remove the soil sleeves from the cup and cap with Teflon caps or Teflon tape covered with polyvinyl chloride (PVC) caps. If required by the SAP, field gas analyzer measurements are taken and recorded on field data sheets at this time.
6. Label each soil sleeve to be submitted for analysis and place samples in a cooler with ice.
7. Backfill hole with native material, or fill hole with cement grout as required in the SAP.
8. Laboratory composited samples (nonvolatile parameters only):
 - a. Collect individual samples at each location to be composited as described above; and
 - b. In the laboratory, homogenize each sample to be included and combine an equal weight of each in the composite. Note: Prior arrangements are required for this step.
9. Field composited samples (nonvolatile parameters only):
 - a. Collect individual samples at each location to be composited as described above;
 - b. Remove an equal volume of soil from each sleeve to be composited and placed in a stainless-steel bowl;
 - c. Homogenize the soil by thoroughly mixing with a stainless-steel spoon;
 - d. Divide the homogenized soil into four equal quarters and collect the composite sample from one of the quarters; and
 - e. Cap the container with a Teflon-lined cap, label, and place in a cooler with ice.
10. Complete the chain-of-custody form and field data sheets.

11. Decontaminate sampling equipment between each sample depth following the procedure described in Section 5.2.

4.2.4 Drilling and Split-Spoon Sampling

Subsurface soil samples from depths of 10 to 120 feet below grade are collected primarily using hollow-stem augering in conjunction with a split-spoon sampler. Other techniques which are used for special conditions are:

- Mud rotary drilling;
- Air rotary drilling;
- Sonication drilling; and
- Dual tube air percussion.

These procedures are described in the Drilling Operations SOP-004.

A split-spoon sampler with soil sleeves is used to obtain samples at five-foot intervals or other designated intervals for chemical analysis, visual observation, lithologic characterization, and soil vapor screening. This type of sampler allows for the collection of relatively undisturbed samples and minimizes losses of volatile and semivolatile species.

The sampler is 18 inches long and up to three inches in diameter. The sampler is split lengthwise to insert/remove the sleeves. As the sampler is driven into the soil, samples are retained in the sleeves.

The procedures for collecting subsurface samples using hollow-stem augering in conjunction with a split-spoon sampler are specified below:

1. Initiate chain-of-custody forms and boring log. Initiate sample-specific data sheet, if any.
2. Using a conventional drill rig, a hole (typically eight or ten inches in diameter) is bored to the required sampling depth. At the desired depth, the drive tip of the bit and the drive shaft are removed. A downhole hammer, or a drill stem with an external hammer, fitted with a split-spoon sampler is then lowered inside the auger stem and driven into the bottom of the borehole. The sampler is then removed from the borehole.

The sleeves are prepared prior to use by:

- Washing in a solution of detergent and potable water;
- Rinsing with potable water;
- Rinsing with DI water; and if necessary
- Baked at 160 degrees C for a minimum of eight hours.

3. After the sampler is removed from the hole, the sleeves are separated and removed from the split spoon. Those sample sleeves selected for analysis are capped with Teflon caps or wrapped with Teflon tape and covered with PVC end caps. Measurements using a field gas analyzer are taken and recorded on field data sheets at this time if required in the SAP. Follow the procedures in the field instrument SOP-020 and SOP-021.
4. If samples are to be retained for nonvolatile chemical analysis, the soil is either left in the sleeve and capped or placed in an appropriate container with minimal disturbance. The container is sealed with a Teflon-lined cap.
5. A portion of the sample is collected in properly-marked sample bags and retained for visual inspection. Information on the soil lithology will be recorded on a boring log (refer to the Drilling Operations SOP).
6. After each sample is collected, the split spoon and tip is decontaminated by the procedures described in the QAPP.
7. In loose formations, a split-spoon sampler equipped with a sample or sand catcher is used to minimize sample loss. The catcher is decontaminated in the same manner used to decontaminate the split-spoon sampler.
8. Label sleeves and place samples in a cooler with ice.
9. The hollow-stem auger flights and split-spoon sampler are steam cleaned between borings.
10. At completion, the borehole is abandoned by backfilling with either bentonite chips or a cement grout to a depth of approximately one-foot bgs or by other procedures described in the SAP. The surface is backfilled with natural material or material to match the surrounding area.
11. Complete boring log and field data sheets.

5.0 REFERENCES

EPA, 1995. *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents.*

6.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE

SOP No: -017

Title: Vapor Sampling

Effective Date: February 1999

1.0 PURPOSE

This SOP describes the procedures for collecting vapor samples from:

- Surface screening;
- Slide hammer and hand auger holes;
- Pneumatic and hand-driven shallow soil gas probes;
- Hydraulically-driven shallow soil gas probes;
- Split-spoon samplers;
- Treatment system off-gases
- Ambient Air
- Downhole (borehole) probes; and
- Soil gas piezometers and dry groundwater monitoring wells.

This SOP includes procedures for collecting samples using:

- Real-time instruments;
- Sorbent tubes;
- Syringes;
- Evacuated, stainless-steel canisters (Summa); and
- Tedlar bags.

2.0 APPLICABILITY

This SOP applies to the collection of air and vapor samples during the remedial investigation (RI), producing data to be used for risk assessment, fate and transport modeling, and monitoring of remedial activities.

3.0 TERMS AND CONDITIONS

DQO-Data quality objective.

FC-Field coordinator.

FID-Flame ionization detector.

FPM-Field project manager.

SAP-Field sampling plan (developed for each site).

GC-Gas chromatograph, used in the field or in an off-site laboratory.

GC/MS-Gas chromatography/mass spectroscopy.

lpm-liters per minute.

PID-Photoionization detector.

QC-Quality control.

4.0 EQUIPMENT AND PROCEDURES

Vapor sampling is performed using a variety of sampling techniques. Selecting the optimum soil gas sampling technique depends on the DQOs for the site or field effort, the site characteristics and accessibility, and the intended use of the analytical results. The rationale for sample collection, including sample locations, analytical methods and QC requirements, and number and type of samples collected, are described in the site-specific SAP. The analytical method selected determines the quantity of the sample, the container or media type, and the storage or holding time required. Sample collection is documented using field log books, field data forms, and chain-of-custody forms as described in the site specific QAPP.

4.1 Sample Collection Procedures

The sample collection procedures and containers described below are used with the different sampling methods described in Sections 4.2 through 4.4.

Measurements can be made using portable direct reading field vapor analyzers or direct reading sorbent tubes for screening-level analyses. Soil gas syringe samples can be collected for field analyses. Stainless steel canister, Tedlar bag, or sorbent tube samples can be collected for laboratory analyses. The described procedures may vary slightly for some techniques described in Sections 4.3 and 4.4, depending on site-specific requirements.

4.1.1 Direct Reading (Real-Time) Instruments

Direct reading instruments are used for field screening analyses. See the FID and PID instrument-specific (SOP-020 and SOP-021) and instruction manuals for operating procedures.

1. Attach gas intake directly to the sampling line during or after purging the soil gas probe, piezometer, well, etc. (purging is described under each individual sampling method).
2. Determine total organic compound concentration in vapor from instrument meter.
3. If the instrument does not draw sufficient flow for concentration measurement or individual sampling techniques, attach the instrument to the purge pump exhaust, or collect a sample in a Tedlar bag and measure the gas concentration in the bag.

4.1.2 Syringe Sampling

Syringe samples are collected for field GC analyses as follows:

1. A fitting containing a Teflon septum must be installed in the sampling line ahead of the purge pump.

2. Purge the required volume (a minimum of three times the volume of the Teflon tubing).
3. A hypodermic syringe equipped with a Mininert valve and hypodermic needle is inserted through a Teflon septum and into the Teflon tubing connected to the probe.
4. The syringe is purged a minimum of three times by extracting 40 to 50 milliliters (ml) (for 50 cubic centimeter (cc) syringes) of soil gas into the syringe, closing the Mininert valve, removing the syringe from the septum, and expelling the gas into the air. The gas can also be injected into a field gas analyzer, i.e. OVM for real-time readings of soil gas concentrations. For smaller or larger size syringes, adjust the purge volume to approximately 90-100% of the rated syringe volume.
5. Collect sample by drawing 10 to 50 cc of soil gas into the syringe, close Mininert valve, and remove from septum. Collect second syringe sample, if required.
6. Cover syringe with foam insulation to protect from reactions with ultraviolet light. Label the sample with a sample control number and complete the field data sheet/chain-of-custody form following the procedures described in the QAPP. Sign over the sample data sheet/chain-of-custody form to the soil gas "runner" or deliver the sample to the field lab for analysis.

4.1.3 Canister Sampling

Canister samples are collected for off-site laboratory analyses by GC or gas GC/MS as follows:

1. A Tee fitting that attaches to the canister is installed in the sampling line ahead of the purge pump.
2. Measure the initial canister vacuum (should be between -27 to -30 inches of mercury [in. of Hg]), attach the canister to the sample line, and the probe, etc., and purge the required volume.
3. Open the vacuum gauge valve on top of the canister to observe the initial pressure. Record the initial pressure.
4. Slightly open the side valve to draw a sample into the canister. Soil gas should be drawn in slowly. Close the valve slightly if a hissing sound is heard.
5. Monitor the canister vacuum gauge. When pressure is between -7 and -5 in. of Hg, close both valves. Cap the sampling port on the canister and record the final pressure.

6. Complete the field data sheet and chain-of-custody form following the procedures described in the site specific QAPP. Sign the canister and chain-of-custody form over to the soil gas runner for shipment to the laboratory for analysis.

4.1.4 Sorbent Tube Sampling

Sorbent tubes are used to collect samples for real-time field analysis (i.e., colorimetric tubes such as Drager tubes) or for off-site laboratory analyses. Colorimetric tubes are read directly. Sorbent tubes are capped, stored on ice (dry ice may be required), and shipped to the laboratory. After purging the sampling line, collect sorbent tube samples as follows:

1. Disconnect the purge pump or field instrument from the sampling line.
2. Connect sorbent tube sampling train to sampling line. The sorbent tube sampling train will consist of a sorbent tube followed by a sampling pump and rotameter.
3. Turn on sampling pump, observe rotameter for correct flow rate for type and size of sorbent tube used (adjust pumping rate as required).
4. Let pump run for required sampling period needed to pass correct sample volume through tube.

4.1.5 Tedlar Bag Sampling

Tedlar bag samples are collected for field or off-site laboratory analyses or to provide a sample for field screening with a direct reading instrument (e.g., OVA) when the instrument pump cannot pull sufficient soil gas from the probe for analysis. This may occur when sample depths are more than approximately 10 feet or the sampling is performed in an impermeable zone.

Tedlar bag samples are collected using an evacuated chamber sampling apparatus. Use a new bag (two to five liters in volume) to collect the sample. Prior to sampling, the following steps are taken:

1. Leak test the Tedlar bags as follows:
 - Pressurize the bags with ultra high purity (UHP) nitrogen to a pressure of two to four inches of water.
 - Connect a manometer using a "T" configuration to monitor the pressure in the bag.
 - Close the valve between the cylinder and the bag and note the manometer indication.
 - Recheck the manometer indication after 10 minutes. A decrease in the bag pressure indicates that the bag is leaking.

- Do not use bags that do not pass the leak test. Attach a label (or some form of identification) to bags that pass.
- 2. If the bags are equipped with valves, make certain that the valve is open before assembling the lung sampler. Evacuate the bag with the vacuum pump prior to use.
- 3. Leak test the sampling train as follows:
 - Turn Valve A to the probe/bag mode.
 - Turn Valve B to the chamber/pump mode.
 - Connect the end of the sample probe to a manometer.
 - Turn on the sample pump until the manometer reads approximately two to four inches of water.
 - Turn the pump off.
 - Observe the manometer indication over a 10-minute period. If the pressure does not change, the sampling system is leak-free and may be used to collect the sample.
 - Any pressure changes indicate that the sampling system is leaking. The source of the leak must either be determined and corrected prior to use, or a different sampling system must be assembled and leak-tested.

The samples are collected as follows:

1. Connect the probe to the sample port.
2. Purge the sample line as follows:
 - Turn Valve A to the probe/purge position.
 - Turn Valve B to the pump/purge position.
 - Turn the pump on and adjust the regulating valve to attain a sample flow of two liters per minute (lpm). Purge the sample line for at least one minute. If the target sampling rate cannot be attained, increase the purge interval to attain a total purge volume of two liters:

Purge Interval (minutes) = 2 / Sampling rate (lpm).

If no flow is attained, either the sampling line is plugged or the sampling probe (i.e., in the well) is positioned in an impermeable layer. During purging, position the pump away from sampling personnel (or ignition sources) to minimize exposure and potential fire hazards.

3. Initiate the sampling as follows:
 - Turn Valve A to the probe/bag position.
 - Turn Valve B to the chamber/pump position.

- Turn the pump on and adjust the regulating valve to attain a sample flow of two lpm.
 - Collect sample for approximately one minute; this will yield a two liter volume of sample. If desired, adjust the sampling time such that the volume of the collected sample is between 50% and 75% of the bag's capacity.
4. During sampling, monitor the following:
 - Sampling rate (adjust the regulating valve to maintain a relatively constant rate).
 - The condition of the bag (i.e., through the view-port) and the sample probe. Look for droplets or particulate build-up in the sample probe. If a significant volume of liquid (i.e., 10 ml) is present in the sample line, a droplet knock-out trap should be inserted between the probe and bag.
 5. After sampling is completed, turn off the pump and open the evacuated chamber to retrieve the bag. If the bag is equipped with a valve, turn the valve to the off-position. If the bag is not equipped with a valve, use Teflon tubing and/or a Swagelok cap (or plug) to seal the bag. Assign a sample ID to the bag and record supporting information on the sample label (e.g., sample date, time, location). Store the sample in a cooler or box (i.e., minimize the exposure of the sample to light) until it can be analyzed. Samples must be analyzed within 24 hours of collection.

4.2 Ground Surface Screening

Gas concentrations may be preliminary measured at the ground surface to identify ambient air vapor concentrations or large emission variations and to select locations for additional investigation.

1. Initiate field data sheet and map according to the procedures in the QAPP and the site-specific SAP. Ensure that instrument is properly calibrated and operating correctly (refer to PID and FID instrument SOP-020 and SOP-021). If samples are to be collected, initiate chain-of-custody forms or sample log and ensure that all sampling equipment is clean.
2. Standing in the area of concern or upwind of the site (at least three to five yards upwind of the investigation area boundary or as specified in the SAP), hold the input probe in the air, approximately five feet above the ground and away from any equipment, etc. Note the reading or average reading after one minute. This is the initial ambient reading. Record location and reading on site map and data sheet.

3. Walk the site on a grid pattern with the inlet probe of the sampling device within three inches of the surface. Walk the site slowly, noting any reading exceeding three times the ambient reading. The grid spacing will be given in the SAP; each pass across the site should be spaced approximately 10-25 feet apart. After verifying the reading by remeasuring the gas at that location, record exceedances on a site map and data sheet.
4. After walking the site, repeat ambient reading at the same location as the initial measurement, provided that the wind direction has not changed. If the wind direction has changed, select a new upwind location for the final ambient measurement. Record location and reading on site map and data sheet.
5. Complete data sheet.
6. If samples were collected, complete chain-of-custody form and label sample following the procedures described in the QAPP, SAP, and workplan. Purge sampling equipment with upwind ambient air for five minutes or until reading is at ambient level, whichever is longer, before initiating next sample.

4.3 Treatment System Vapor Sampling Methods

Certain remedial actions i.e., vapor extraction and air stripping, result in the emissions of vapors. These vapors may be exhausted directly to the atmosphere or treated prior to being exhausted. In either situation, contaminant concentrations being removed and the volume of contaminants being released to the atmosphere need to be monitored. Procedure for the collection and recording of the vapor samples are as follows:

1. Initiate field data sheet and map according to the procedures in the QAPP and the site-specific SAP. Collect initial readings using field screening methods, i.e., OVM. Ensure that instrument is properly calibrated and operating correctly (refer to SOPs). If samples are to be collected, initiate chain-of-custody forms or sample log and ensure that all sampling equipment is clean.
2. Determine vapor flow rates by collecting multi-flow rate readings across the exhaust port using a cross-sectional basis, average the flow rates, and multiple by the area of the exhaust port to determine flow rate.
3. Collect sample in canister, at a low flow rate. Label sample, complete chain-of-custody form, and submit to laboratory.
4. Upon receipt of laboratory analytical results, compare data with field screening values and build-up data base for comparison purposes during future testing

4.4 Shallow Soil Gas Sampling Methods

The methods that may be used for shallow soil gas sampling include:

- Slide hammer hole method;
- Hand auger hole method;
- Hand-driven probe method;
- Pneumatic probe method; and
- Hydraulic probe method.

Slide hammer, hand auger, and the hand-driven methods are best used for small site investigations where only a few samples are needed, or in remote areas where access for the equipment required for other methods is difficult. The pneumatic and hydraulic methods are designed for extensive soil gas investigations where 15 or more samples are required per day.

4.4.1 Shallow Soil Gas Equipment Decontamination Procedures

1. Sampling equipment (slide hammer, hand auger sampling probes) is decontaminated by brushing soil from the equipment, washing with detergent, steam cleaning, and rinsing with potable and DI water.
2. Stainless steel or Teflon sampling tubing is decontaminated between uses by purging with ambient air for five minutes or until field FID/PID readings are at ambient levels, whichever is longer. The vacuum of the field instrument or the vacuum pump is used to purge the tubing. Daily equipment blanks are collected in syringes to verify that decontamination is effective (when a field GC is being used for the field effort). Teflon tubing is replaced after five uses, or as needed if blanks indicate contamination.
3. Septa used for syringe sample collection are replaced daily, or more often if required.
4. Glass sampling syringes, retractable probe tips, and stainless steel sampling manifold fittings are baked in an oven at least eight hours at 120 degrees C. Syringe blanks are analyzed to ensure that bakeout has removed all volatiles.

4.4.2 Slide Hammer or Hand Auger Hole Method

Shallow soil gas may be sampled using a slide hammer to drive a rod into soil, providing a hole that will accept a sampling tube. The slide hammer is a steel rod with a weighted sliding handle used to drive the rod into the ground. The rod is three to six feet in length with a 5/8-inch diameter head. The weighted handle of the rod is used to drive the rod into the ground with repeated downward blows. Shallow soil gases may also be measured and collected from hand auger holes in conjunction with soil sampling. The field procedure is as follows:

1. Initiate field data sheet and chain-of-custody form or sampling log, if applicable, following the procedures in the QAPP and SAP.
2. The slide hammer or hand auger is used to drive the rod to the desired depth.
3. A 1/4-inch Teflon or stainless steel tube is inserted down the hole. Tube depth is measured relative to the depth of the auger stem or slide hammer to prevent soil clogging the end of the tube.
4. Soil gas samples are drawn through Teflon or stainless steel tubing connected to the field gas analyzer or a vacuum pump.
5. If a discrete sample is needed for laboratory analysis, disconnect field instrument and connect the sampling device to the tubing.
 - a. Cover the boring opening with wood or plastic that has a hole for the sample tubing to pass through; this prevents soil gases from mixing with ambient air or escaping from the boring.
 - b. Withdraw a sample through the tubing at a rate specified for the sampling apparatus and/or analytical method.
 - c. To collect syringe samples for field GC analysis:
 - i. Install a septum in the sampling line upstream of the field instrument. The field instrument is left in place during sampling to assure the continued flow of soil gases at the septum.
 - ii. Purge the syringe with soil gas three times.
 - iii. Collect a sample.
 - d. To collect canister samples for of site analysis:
 - i. Disconnect the field instrument from sampling line.
 - ii. Connect the canister to the sampling line; a Swagelok tee fitting can be used to preconnect the sample container.
 - iii. Collect the sample.
 - e. To collect a sorbent tube or Tedlar bag sample:
 - i. Disconnect the field instrument from the sampling line.
 - ii. Connect sorbent tube or Tedlar bag sampling train to sampling line. The sorbent tube sampling train will consist of a sorbent tube followed by a sampling pump and rotameter. The Tedlar bag sampling train will consist of an oil-less vacuum pump and Tedlar bag.
 - iii. For sorbent tube--turn on sampling pump, observe rotameter for correct flow rate for type and size of sorbent tube used (adjust pumping rate as required), and let pump run for period needed to pass correct sample volume through tube.
 - iv. For Tedlar bag sample--turn on sampling pump and let run until bag is filled. Do not fill bag to above atmospheric pressure.

6. Complete chain-of-custody form, if applicable, and field data sheet.
7. Decontaminate the sampling tube and other equipment.
8. Backfill the hand auger hole with native soil or grout as specified in the SAP.

4.4.3 Hand-Driven and Pneumatic Methods

The hand-driven probe or pneumatic driven probe methods may be used for extensive shallow soil gas sampling investigations. These methods are semi-portable and can be used in relatively remote areas or areas that have confined access. The probes consist of a hollow 3/4-inch outside diameter chrome/molybdenum steel alloy tube attached to a perforated, retractable, stainless-steel probe tip or disposable steel soil gas sampling tip; other probe and tip configurations may be used. The probes are driven into the soil to a depth of three to six feet bgs with a slide hammer, sledge hammer, or a pneumatic hammer attached to the top of the probe. The sampling procedure is as follows:

1. Probe Placement:
 - a. Measure probe location from a known reference point; locate on the site map.
 - b. Initiate field data sheet/chain-of-custody form following the procedures described in the QAPP and SAP.
 - c. Retrieve a decontaminated soil gas probe, sampling tip, and Teflon tubing; assemble sampling probe.
 - d. Purge Teflon tubing with vacuum pump for three to five minutes. Collect an equipment blank if designated.
 - e. Using the selected probe driving method, drive probe three to six feet bgs.
2. Sample Extraction:
 - a. Attach Teflon tubing from probe to sampling manifold and vacuum pump intake (connect canister sampling line to manifold).
 - b. Retract probe two to three inches to expose sampling ports on tip.
 - c. Turn on vacuum pump to measure pressure (should be -10 to -29 in. Hg). If the pressure is greater than -10 in. Hg, check for leaks or improper seal around the probe. If the pressure is less than -29 in. Hg, retract probe two to three inches while pulling a vacuum until more than -29 in. Hg is obtained. If these conditions are not met, relocate probe.
 - d. Purge three to five tubing volumes of soil gas. Use a graph showing purge times for tubing length and vacuum readings. Monitor flow meter to determine when purging is complete.
 - e. Close the valve and turn off the vacuum pump.
3. Sample Collection:
 - a. To collect a syringe sample:

- i. A hypodermic syringe equipped with a Mininert valve and hypodermic needle is inserted through a Teflon septum and into the Teflon tubing connected to the probe.
 - ii. The syringe is purged a minimum of three times by extracting 40 to 50 ml (90-100% of rated syringe volume) of soil gas into the syringe, closing the Mininert valve, removing the syringe from the septum, and injecting the gas into the air (the gas can also be injected into an organic vapor monitor for real-time readings of soil gas concentrations).
 - iii. Collect sample by withdrawing 10 to 50 cc of soil gas into the syringe, close Mininert valve, and remove from septum. Collect second syringe sample, if required.
 - iv. Cover syringe with foam insulation; label sample with sample control number and complete field data sheet/chain-of-custody form following the procedures described in the QAPP. Sign over sample data sheet/chain-of-custody form to soil gas runner or deliver sample to field lab for analysis.
 - b. To collect a canister sample:
 - i. Open vacuum gauge valve on top of canister to observe initial pressure. Record initial pressure.
 - ii. Slightly open side valve on canister to draw sample into canister. Soil gas should be slowly drawn into the canister. Close valve slightly if a hissing sound is heard.
 - iii. Watch canister vacuum gauge. When pressure is between -5 and -7 in. Hg, close both valves. Cap sampling port on canister and record final pressure.
 - iv. Complete field data sheet and chain-of-custody form following the procedures described in the QAPP. Sign canister and chain-of-custody form over to soil gas runner for shipment to the laboratory for analysis.
4. Demobilization and Decontamination:
- a. Disconnect vacuum pump from Teflon tubing.
 - b. Extract probe with jack/puller and place in used probe bin. The jack/puller is a clamp that is placed around the probe, and is connected to a hydraulic jack which extracts the probe.
 - c. Fill hole with concrete or fill material as designated in the SAP.
 - d. Purge Teflon tubing with vacuum pump for three to five minutes. If field gas analyzer readings exceeds the ambient air reading by one part per million by volume (ppmv) or more, replace tubing.
 - e. Mark location with field tag.
 - f. Decontaminate all equipment.

If the QC schedule indicates a field duplicate sample is to be collected, a second probe is placed within 10 feet of the original location using the same procedures. If nested duplicates are designated, a second sample is collected from the first probe.

4.4.4 Hydraulic Method

The hydraulic sampling technique presented here is taken from Tracer Research Corporation (TRC); an equivalent method can be employed when other subcontractors are employed. The technique requires a vehicle with a hydraulic probe driving capability and field laboratory instrumentation to provide soil gas analysis by real-time field analysis. A field laboratory or mobile field laboratory is used and consists of a vehicle equipped with GC(s) using FID, PID, or ECD with packed and capillary columns. Soil gas sampling subcontractors are supervised by base supplier field personnel.

Soil gas samples are collected from the vadose zone through steel probes. A specialized hydraulic mechanism pushes and withdraws the sampling probes by transferring the weight of the vehicle onto the probe. The probes are seven-foot lengths of 3/4-inch diameter steel pipe flued with detachable steel drive points. A percussion hammer can assist in driving probes through soil containing cobbles or through unusually hard soil. The standard operating procedure (SOP) is as follows:

1. Probe Placement:
 - a. A clean probe (pipe) is removed from the "clean" storage area.
 - b. The soil gas probe is placed in the pusher/puller mechanism.
 - c. A drive point is attached to the bottom of the probe.
 - d. A driving mechanism (weight of the vehicle) is used to push the probe three to six feet into the ground.
 - e. If the mechanism cannot push the probe deep enough into the ground, a hydraulic hammer is used to pound the probe into the ground.
 - f. The probe is retracted two to three inches to detach the tip and expose the screen.
2. Sample Extraction:
 - a. An adapter is put onto the top of the soil gas probe.
 - b. A vacuum pump is hooked onto the adapter.
 - c. The vacuum pump is turned on and used to evacuate soil gas.
 - d. Evacuation takes at least 30 seconds but never more than five minutes for samples having evacuation pressures less than -15 in. Hg. Evacuation times are at least one minute but no more than five minutes for samples having evacuation pressures greater than -15 in. Hg.
 - e. Gages on the vacuum pump are checked for excessive soil gas flow resistance by monitoring pressure reading (inches of Hg). A gage reading of at least two inches Hg less than the maximum observed value is required to extract sufficient soil gas to collect a valid sample.

3. Sample Collection:
 - a. With the vacuum pump running, a hypodermic syringe needle is inserted through the silicone rubber and into the stainless steel tubing of the adapter.
 - b. Gas samples only contact steel surfaces, never with potentially sorbing materials (i.e., tubing, hose, pump diaphragm).
 - c. The syringe is purged with soil gas. Without removing the syringe needle from the adapter, a 10-cc soil gas sample is collected.
 - d. A second 10-cc sample is collected using the same procedure.
 - e. If required, canister, sorbent or Tedlar bag samples are collected as described in Section 4.1.
4. Demobilization:
 - a. Following analysis, the vacuum pump is turned off and disconnected from the adapter.
 - b. The adapter is removed and stored with equipment to be cleaned.
 - c. The probe is removed from the ground and stored in the "used" probe tube.
 - d. The probe hole is backfilled with native soil or grout as required in the SAP.
 - e. Complete all field data sheets and chain-of-custody forms.
5. Decontamination:
 - a. Decontamination of probes, tubing, fittings, and syringes follows the procedures described above.
 - b. Equipment blanks (syringe and probe) are collected daily prior to sampling to ensure that no contamination exists in the sampling system.

4.4.5 Deep Soil Gas Sampling Methods

The soil gas sampling methods that may be used for deep soil gas sampling includes the following:

- Downhole method;
- Split-spoon method;
- Soil gas monitoring well method; and
- Dry groundwater monitoring well method.

Downhole and split-spoon methods are used to locate areas of contamination and choose soil sampling locations during drilling. Soil gas monitoring wells and dry groundwater monitoring wells are used for collecting soil gas samples from the vadose zone, typically for long-term monitoring of the soil gas concentrations or to monitor the effectiveness of soil gas extraction systems.

Downhole Method

Downhole soil gas sampling, in conjunction with hollow-stem augering and sonication drilling methods, helps determine the extent of subsurface contamination and select soil samples for analysis. The probe is a hollow 3/4-inch outside diameter chrome/molybdenum steel alloy tube attached to a perforated, retractable, stainless-steel tip. The probes are driven two to three feet beyond the auger head or drill bit using the downhole hammer and rod.

1. Probe Placement:
 - a. Initiate field data sheet/chain-of-custody form following the procedures described in Section 6.0 in Volume I of the QAPP and SAP.
 - b. Retrieve a decontaminated downhole soil gas probe, sampling tip, and Teflon tubing; assemble probe.
 - c. Purge Teflon tubing with vacuum pump for three to five minutes.
 - d. Use downhole hammer to drive probe from two to three feet below the lead auger.
2. Sample Extraction:
 - a. Attach Teflon tubing from the probe to the sampling manifold and vacuum pump intake (connect canister sampling line to manifold).
 - b. Retract probe two to three inches to expose perforations on sampling tip.
 - c. Turn on vacuum pump, measure pressure (the pressure should be -10 to -29 in. Hg). If the pressure is greater than -10 in. Hg, check for leaks or improper seal around the probe. If the pressure is less than -29 in. Hg, retract probe two to three inches while pulling a vacuum until greater than -29 in. of Hg is obtained. If these conditions are not met, relocate probe.
 - d. Purge three to five tubing volumes of soil gas. Use graph showing purge times for tubing length and vacuum readings for the vacuum pump to determine purge requirements. Monitor flow meter to determine when purging is complete.
 - e. Measure the exhaust from the vacuum pump with a direct reading instrument (typically a PID) and record on a field data sheet.
 - f. Close the valve at the inlet to the vacuum pump and turn off the vacuum pump.
3. Sample Collection:
 - a. To collect a syringe sample:
 - i. A hypodermic syringe equipped with a Mininert valve and hypodermic needle is inserted through a Teflon septum and into the Teflon tubing connected to the probe.
 - ii. The syringe is purged at least three times by extracting 40 to 50 cc (or 90% to 100% of rated volume) of soil gas into the syringe, closing the Mininert valve, removing the syringe from the septum,

- and injecting the gas into the air. The gas can also be injected into an OVM for real-time readings of the soil gas concentration.
- iii. Collect sample by withdrawing 10 to 50 cc of soil gas into the syringe, close Mininert valve, and remove from septum. Collect second syringe sample, if required.
 - iv. Cover syringe with foam insulation to protect from light. Label sample with sample control number and complete chain-of-custody form following the procedures in the QAPP. Sign sample data sheet/chain-of-custody form over to soil gas runner or deliver sample to field lab for analysis.
- b. To collect a canister sample:
 - i. Open vacuum gauge valve on top of canister to observe initial pressure. Record initial pressure.
 - ii. Slightly open side valve on canister to draw sample into canister. Soil gas should be slowly drawn into the canister. Close valve slightly if a hissing sound is heard.
 - iii. Watch canister vacuum gauge. When pressure is between -7 and -5 in. Hg, close both valves. Cap sampling port on canister and record final pressure.
 - c. To collect a sorbent tube sample:
 - i. Connect sorbent tube sampling train to sampling line. The sorbent tube sampling train will consist of a sorbent tube followed by a sampling pump and rotameter.
 - ii. Turn on sampling pump and observe rotameter for correct flow rate for type and size of sorbent tube used. Adjust pumping rate as required.
 - iii. Let pump run for the time needed to pass correct sample volume through tube.
 - d. To collect a Tedlar bag sample, follow the procedures described in Section 4.1.5.
4. Demobilization and Decontamination:
- a. Disconnect vacuum pump from Teflon tubing.
 - b. Extract probe, place probe in used probe bin.
 - c. Purge Teflon tubing with vacuum pump for 10 to 15 minutes. If direct instrument readings exceed 1 ppmv above ambient air reading, replace tubing.
 - d. Decontaminate all sampling equipment following the procedures described above.
 - e. Backfill the borehole with native material or grout as specified in the SAP.

Split-Spoon Sampling

Soil gas concentrations may be measured and sampled during drilling operations with split-spoon soil samples. Soil gas is measured with portable field instruments as follows:

1. Separate split-spoon sample sleeves.
2. Insert the instrument probe between the sampling sleeves. Dispersion of the gases is minimized during sampling by using a cap with an opening for the sampling instrument probe.
3. Record data on the drilling log form for the borehole.

Soil Gas Monitoring Well (Piezometer) Method

Soil gas monitoring wells or piezometers provide long-term monitoring of soil gas concentrations in much the same manner that groundwater monitoring wells are used to monitor groundwater concentrations. A soil gas piezometer differs from a groundwater well in that the screen is installed in the vadose (unsaturated) zone. Piezometer screens are installed at varying depths (piezometer nest); from one to six piezometers may be grouped within each nest, depending on the DQOs for the site.

Soil gas monitoring wells are installed in a borehole drilled to the proper depth using a HSA drilling rig. The wells are typically fabricated using one-inch-diameter PVC casing fitted with a two-foot screen at the bottom of the casing. The top of the well is completed with a sealed fitting to which soil gas sampling devices can be connected. Samples are collected as follows:

1. Initiate chain-of-custody form. Record the location, piezometer number, date, time, and barometric pressure on the field data sheet.
2. Attach the sampling line and purge pump to the top of the piezometer. Turn on purge pump and measure flow rate with rotameter.
3. Purge well for the required purge volume.
4. Measure soil gas concentration with a direct reading instrument, and collect syringe, canister, sorbent tube, or Tedlar bag samples as described in Section 4.1, above.
5. Complete chain-of-custody forms and field data logs.
6. Decontaminate sampling manifold and purge pump by purging with ambient air for five to 10 minutes or until field instrument readings are equivalent to ambient

levels, whichever is longer. If field instrument readings remain elevated above ambient levels after 15 minutes, replace sampling line.

Dry Groundwater Monitoring Wells

Soil gas samples may be collected from groundwater monitoring wells where the water table has dropped below the bottom of the well screen. The soil gas samples may be collected by modifying a packer, so the screened interval can be isolated from the remainder of the well casing. A packer with a sampling tube installed through the packer is inflated directly above the top of the well screen. Soil gas is then collected from below the packer in the same manner that piezometers are sampled. The sampling procedure is as follows:

1. Locate sampling vehicle at well to be sampled.
2. With a groundwater sounder, determine if water is in the screened interval. If water is present, notify the field coordinator before proceeding with sampling.
3. Attach a Teflon sampling line to the downhole packer. Lower the packer to a depth of three feet above the well screen and inflate (check construction log to determine the depth to the top of the screen).
4. Calculate the isolated well volume based on the total depth determined in Step 2 and the packer depth.
5. Attach sampling line to sampling manifold and purge pump.
6. Turn the purge pump on and determine flow rate using a rotameter. Calculate the required purge time. Continue purging well.
7. Measure the soil gas exhausted from the vacuum pump with direct reading instruments.
8. After purging the required soil gas volume, collect syringe, canister, sorbent tube, and/or Tedlar bag samples as described in Section 4.1 above.
9. Deflate packer and raise the packer and sampling tube to the surface. Remove sampling tubing and decontaminate by purging with ambient air for five to 10 minutes or until field instrument readings are equivalent to ambient levels, whichever is longer. If field instrument readings remain elevated above ambient levels after 15 minutes, replace sampling line.
10. Secure the well.

5.0 REFERENCES

EPA, 1995. *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents*.

6.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE

SOP No: -020

Title: Field Instrument: Photoionization Detector (PID) Calibration and Operation

Rev: No. 2

Effective Date: February 1999

1.0 PURPOSE

Photoionization is a detection method used in several types of portable, real-time instruments to detect organic and inorganic vapors in air. Commonly referred to as PIDs, these instruments provide data for on site, real-time total vapor measurement, evaluation of existing conditions, refinement of sampling locations, and health and safety evaluations. The data generated are considered qualitative in nature, although limited quantitative data are also generated. PIDs are not species-specific.

This SOP describes field operation methods, outlines routine field maintenance, and discusses calibration procedures for some of the commonly used PID makes and models: the Thermo Environmental OVM Model 580B; the HNU PI-101; and the Photovac MicroTIP (Total Ionizables Present).

2.0 APPLICABILITY

This SOP is designed for field personnel who use PIDs to measure VOCs during RI activities, routine groundwater sampling, or health and safety evaluations. An important consideration when selecting a real-time instrument for field investigations is how well the particular instrument responds to a class of contaminants. In general, PIDs respond better to aromatic hydrocarbons (BTEX) and chlorinated aromatic hydrocarbons. PIDs do not generally respond to methane. The applicability of the PID for measurement of a particular compound can be determined by comparing the ionization potential (IP) of the compound to the ionization energy of the PID light source; the IP must be lower than the source energy.

2.1 Limitations

The PIDs have certain limitations:

- The OVM is a nonspecific total gas detector; any compound with an ionization potential within the range of the light source (i.e., bulb) and detector bulb will register a reading in parts per million (ppm).
- Compounds above the ionization potential of the bulb will not properly register, because the ionization potential does not provide an electrical volt potential that can be registered by the detector. For example, an OVM fitted with a 10.2 eV bulb will not register Freon 113 because the ionization potential of Freon 113 is 11.78 eV.

- Power lines, power transformers or other sources of radio frequency interference (RFI) in close proximity to the PID may cause measurement errors. The effect of the RFI generator on the instrument is dependent upon the amount of energy being produced by the RFI generator and its distance from the instrument (i.e., do not use two-way radios within 20 feet of the detector and do not use near radar installations).

3.0 TERMS AND DEFINITIONS

Electron Volts:	See Ionization Potential.
Ionization Chamber:	Point within the detector assembly where ionization occurs.
Ionization Potential:	The energy required by atomic particles to become excited and jump to a polarized electrical field, measured as electron volts (eV).
Ionization Source:	The energy source that allows ionization to occur (in this case an ultraviolet lamp).
Photoionization:	The use of ultraviolet (UV) energy to excite atomic particles into ionization.
Radio Frequency Interference:	Radio wave energy that causes unwanted electrical interference; i.e., static or snow on a television screen.

4.0 EQUIPMENT AND PROCEDURE

4.1 Equipment

Thermo Environmental 580B organic vapor monitor (OVM)
 HNU Systems, PIIOI
 Photovac MicroTIP
 Isobutylene standard calibration gases (100 ppmv and 1,000 ppmv)
 Ultra high purity (UHP) air
 15 liter Tedlar bag for calibration standards

This SOP describes the calibration and operation procedures for an OVM Model 580B, manufactured by Thermo Environmental Instruments, Inc. Refer to the manufacturer's instructions for different instruments. The instruments are calibrated prior to use on a daily basis. If high concentrations are detected over a prolonged period and the meter is reading high ambient levels, the OVM should be recalibrated.

4.2 Thermo Environmental 580B OVM

4.2.1 Calibration

To calibrate the Thermo Environmental Model 580B:

1. Charge the OVM prior to use in the field. The proper procedure for charging the OVM 580B is in the maintenance section of this SOP. For other makes or models refer to the user's guide for that instrument.
2. Remove the PID from its battery charger.
3. Insert the power plug into the power receptacle.
4. Depress the ON/OFF key on the top control panel until a distinct buzzing is heard from the PID. (The sound of the pump that draws air through the PID). The instrument should begin to display readings. Allow the instrument to warm up for five minutes.
5. Press the MODE/STORE key on the control panel one time. Pressing this key takes the unit out of reading/display mode and puts it into one of several service modes.
6. Press the -/CRSR key on the control panel four times. This cycling brings the unit into its calibration mode.
7. Press the RESET key and then -/CRSR key. The unit is now ready to set its internal memory for ambient (or background) air levels.
8. Press the RESET key. Allow the OVM to draw in ambient air until the display on the control panel reads SPAN PPM = 0000 (or any other value the unit has been pre-programmed with).
9. Press +/-INC key. Attach the calibration span gas to the probe tip.
10. Press the RESET key. Allow the unit to draw in span gas until the display panel readout is equal to the span gas concentration being supplied to the unit.
11. Press the MODE/STORE key and then the RESET key. The instrument is now calibrated.
12. Press the ON/OFF switch to turn the unit's pump off until the unit is ready for field service (to conserve battery power).

4.2.2 Field Operations General Guidelines

After calibration, the OVM is ready for field use. When it is not in use the machine can be turned off by pressing the ON/OFF button. The machine is still on, but the pump is not operating. This does not affect the calibration in any way, but will prolong the battery life. When the OVM is not in use, it should be stored in its carrying case to avoid accidental damage.

When measuring contaminants at the source, do not stick the probe tip into the sample (soil or water). Foreign matter can be inadvertently drawn up the inlet tube into the ionization chamber or the pump housing. This matter can plug, foul, or even damage the unit, rendering it inoperable.

Allow several seconds for the OVM to record an accurate reading. On outdoor field projects in cold and/or wet weather conditions, the unit may take a full minute or more to register the optimum reading from the sample.

Do not operate downwind from a generator or other sources of organic or inorganic vapors, because unburned compounds in the fuel for these devices may adversely affect the sample reading at the worksite.

Also, hold a felt tipped marker at the sample inlet tube. The volatile compounds in the marker should react within the unit to produce a reading nearing 100 ppm on the display panel.

Health and Safety Screening

To monitor for exposure to personnel conducting groundwater sampling or drilling operations or any other potential exposure site, make sure the OVM is on and displaying "0000.0 ppm." Measurements are to be taken while standing upwind of any potential contamination. Point the probe at the area, to be measured and watch the display. If there is some contamination, the reading displayed should stabilize and be recorded on a health and safety screening sheet or other appropriate data sheet.

Soil Core Screening

To use the 580B OVM for screening soils a screening adapter is attached to the end of the probe. This adapter is fitted onto the OVM probe using Swagelok fittings to ensure a leak-free connection. The adapter is cup-shaped to fit over a soil core, minimizing exposure to ambient air.

Make sure the OVM is on and displaying "0000.0 ppm." Readings need to be taken while standing upwind of any potential contamination. Record all readings on the drilling log or other appropriate data sheet. After each reading is taken, remove any soil from the sample cup and OVM probe. Clean out any soil that may have been caught in the probe or the cup. Periodically, the OVM needs to be checked to see if it is still zeroing after each measurement.

This can be done by taking a reading upwind of the screening area. If the OVM does not zero, it needs to be recalibrated or replaced with another OVM.

Post Calibration

At the end of the day, the OVM needs to be post-calibrated. This is just a check. The span gas is hooked up and the display reading is recorded in the field calibration log. The instrument does not need to be recalibrated at this time. The plug on the back of the OVM should be removed at this time. The battery charger cable should be plugged into this socket and left to recharge overnight. At the beginning of the day and periodically thereafter, take a reading of the ambient air for background concentrations.

4.2.3 Maintenance

Charging

- Remove the power plug from the back of the unit. Place the charging plug from the charging unit into the receptacle for the power plug. Plug the 110 volt plug from the charger assembly into a wall receptacle. The battery for the unit must never be discharged below 10.8 volts; if this occurs, the battery will be damaged and the PID unit will be inoperable. The 580B PID uses a gel style battery that should be on a charger any time the unit is not being used. A flashing "B" symbol is displayed before the unit's battery is fully discharged.

Lamp Service

Follow procedures stated below or send to a qualified repair technician.

The lamp window must be cleaned periodically to ensure proper ionization of the air and correct ppm measurements.

Cleaning of the lamp requires removing the lamp from the unit's housing.

1. Remove the four housing mounting screws on the bottom of the unit. The screws need only be loosened until the bottom of the housing releases and will not come out of the housing bottom completely.
2. Loosen the two wing nuts on the side of the detector assembly that secure the high-voltage supply to the detector assembly. Remove the high-voltage supply from the detector assembly.
3. Loosen and remove the lamp assembly anchor ring from the detector assembly.

4. Remove the lamp from the detector assembly and polish with aluminum oxide scouring powder (usually supplied with the PID when it is purchased or rented). After the lamp has been polished, replace it in the detector assembly and reverse the disassembly steps.

Pump Service

1. Remove housing as outlined in manufacturer's manual.
2. Remove pump securing bracket screws.
3. Disconnect pump tubes from detector assembly.
4. Clean any foreign matter or debris from tubing and pump housing.
5. Reassemble by reversing the disassembly order.

5.0 REFERENCES

EPA, 1995. *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents*.

Thermo Environmental Instruments Inc. Instruction Manual OVM/DATALOGGER, 8 West Forge Parkway, Franklin, MA 02038.

6.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE

SOP No: -024

Title: Field Instrument: Calibration and Operation of Water Sampling Field Instruments

Effective Date: February 1999

1.0 PURPOSE

This SOP provides a detailed description of the equipment and procedures used to measure the pH, conductivity, and temperature of groundwater samples collected from monitoring and extraction wells. The steps for calibration and operation are included.

2.0 APPLICABILITY

This SOP is for personnel who are collecting groundwater and surface water samples.

3.0 TERMS AND DEFINITIONS

uS - micro Siemens

DI - Deionized

N/A - Not applicable

4.0 EQUIPMENT AND PROCEDURES

During groundwater sampling activities, pH, conductivity, and temperature are measured to determine that water flowing into the well represents "fresh" water from the aquifer, not stagnant water from the well casing. These field parameters are also measured during surface water sampling. This SOP describes the calibration and operation procedures for pH and conductivity meters manufactured by Cole-Palmer. Refer to the manufacturer's instructions for different instruments. The instruments are calibrated when the sampling team arrives at the well, prior to purging any water, or at the surface water sampling location.

4.1 Procedures

The pH and conductivity are determined using a pH meter, Model 59000-20, and a conductivity meter, Model 19800-20, manufactured by Cole Palmer or similar.

4.1.1 Conductivity Meter Calibration

Equipment

To calibrate the conductivity meter the following equipment is needed:

- Conductivity meter.
- Two calibration solutions, bracketing the expected range of conductivity measurements.
- DI water.
- Three - four to eight ounce (oz.) widemouth bottles for the calibration solutions and the DI water.
- Small screwdriver to adjust meter.

Calibration

Prior to taking measurements, the conductivity meter must be calibrated:

1. Pour the calibration solutions and DI water into separate containers.
2. Remove the cap from the bottom of the conductivity meter. Turn the meter on and immerse it into approximately one inch of DI water. Do not submerge the meter above the brown line as the electronics will be damaged and the meter will need to be replaced.
3. Place the meter into the first calibration solution. Wait approximately 20 seconds for the meter to equilibrate.
4. Adjust the meter, if necessary, with the small screwdriver until the digital readout has the same value as the calibration solution.
5. Rinse with DI water.
6. Repeat the procedure for the second calibration solution.
7. Record all readings on the field data sheet in the calibration section.

4.1.2 pH Meter Calibration

Equipment

To calibrate the pH meter the following equipment is needed:

- pH meter;
- Two calibration solutions bracketing the expected ranges of pH to be measured (usually pH four and ten);

- DI water;
- Three - four to eight oz. widemouth bottles for the calibration solutions and the DI water.

Calibration

The procedure to calibrate the meter is:

1. Pour calibration solutions and DI water to a depth of one inch into separate containers.
2. Remove the cap from the bottom of the pH meter. Turn the meter on and rinse with the DI water. Do not submerge the meter above the brown line as the electronics will be damaged and the meter will need to be replaced.
3. Place the meter into the first calibration solution.
4. Press the CAL button to enter the calibration mode. CAL flashes and the current reading is displayed. Let the meter flash for about 20 seconds and then press the HOLD/CON button to confirm the reading. CO and the calibrated reading should appear on the display.
5. Rinse with DI water.
6. Repeat the procedure for the second calibration solution.
7. Record all readings on the field data sheet in the calibration section.

Thermometers

Thermometers are calibrated yearly by comparison with a NIST reference thermometer.

4.3 Operation

Water sample pH, conductivity, and temperature are measured in the field during monitoring well purging, and prior to surface water sampling. The following steps are performed for the measurements:

1. A sample of approximately 100 ml is collected in a four to eight oz. widemouth sampling bottle and the pH and conductivity meters are immersed into the water sequentially. Do not submerge the instruments above the brown line on each meter.

2. The meters are turned on at this time, and should be allowed to stabilize for approximately 20 seconds before recording a reading.
3. Measure and record the temperature.
4. The readings are recorded on the data sheet, groundwater purging or monitoring log.
5. For groundwater sampling, when a bailer is used, a minimum of five readings are necessary during the purging of a well. Before the groundwater samples can be collected, the pH, conductivity, and temperature readings must stabilize; the pH cannot vary by more than 0.1 pH units, the conductivity cannot vary by more than 50 units, and the temperature cannot change by more than one degree C. These must be for successive readings and the volume of water discharged between the two readings must be more than 20% of the total volume discharged. All readings are recorded on the field sampling data sheet.
6. After well purging is completed for wells with dedicated systems, the pH, conductivity, and temperature are measured again. If the well has both a purge and bladder pump, after switching to the bladder pump, additional readings must be taken until they are within the ranges specified above or until one screened interval volume is removed. If the parameters are still not in within the specified ranges, the sample is collected and a note made on the field data sheet. The final parameter readings should be noted on the field data sheet.

5.0 REFERENCES

EPA, 1995. *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents*.

Instruction manual, pH tester, Cole-Palmer.

Instruction manual, Conductivity tester, Cole-Palmer.

6.0 ATTACHMENTS

None.

STANDARD OPERATING PROCEDURE

SOP No: -028

Title: Data Review Procedures

Effective Date: February 1999

1.0 PURPOSE

This SOP defines the procedures used to evaluate analytical data. The procedures include analytical report and electronic data review, batch QC assessment, and assessment of data quality through QC sample result interpretation.

2.0 APPLICABILITY

The procedures described in this SOP are applicable to projects where samples are collected and analytical data are produced. The use of these procedures by qualified personnel will assure that analytical and reporting errors are minimized, and that any problems which may affect data quality can be identified and addressed. All reports that incorporate analytical results should include an assessment of the data quality as described in this SOP.

3.0 TERMS AND DEFINITIONS

Accuracy:	The ability of a procedure to determine the "true" concentration of an analyte.
Analyte:	A specific chemical compound or physical parameter measured in a chemical analysis.
Bias:	A systematic deviation from the actual concentration. A high or low bias potential is indicated by the direction of the QC sample recoveries.
Data quality objective (DQO):	Qualitative and quantitative statements formulated at the start of any study to establish the data quality required from sampling and analysis procedures.
Equipment blanks for gas-phase sample:	Sample of ambient air collected in the field and processed using the same sampling and handling procedures as field samples. The results identify potential contaminant sources in sample collection and handling procedures.

Field duplicate sample:

A second sample collected at the same location as the original sample. Results assess precision, including variability associated with the laboratory analysis and the sample collection process, and natural variabilities in the samples.

Holding time:

The maximum amount of time a sample can be stored before analysis as specified by the QAPP.

Laboratory control sample (LCS):

Blank spike containing analytes of interest at a specified concentration that experiences the entire sample preparation and analysis process. The sample demonstrates that the method/instrument is operating within acceptable accuracy limits.

Matrix spike (MS):

Solution of target analytes at known concentrations spiked into a field sample before sampling preparation and analysis. The MS provide estimates of bias due to matrix interferences.

Matrix spike duplicate (MSD):

A second aliquot of a sample spiked with the same solution as the first and that is analyzed by the same method. Results of the analysis of the duplicate spiked samples are used to compare recovery differences between samples and to evaluate the method's precision.

Method blanks:

A sample composed of all reagents used to ensure that interferences from the analytical system, reagents, and glassware are under control. For gas phase analyses, a reagent blank is a sample of ultrapure nitrogen gas that is carried through the entire analytical system.

Percent recovery:

Percentage of analyte recovered (for LCS or surrogate spikes) is calculated by:

$$\text{Percent Recovery} = \frac{\text{Concentration reported}}{\text{Concentration spiked}} \times 100$$

$$\text{Matrix Spike Percent Recovery} = \frac{\text{Concentration reported} - \text{Original sample concentration}}{\text{Concentration spiked}} \times 100$$

Performance evaluation
(PE) audit:

Submittal of PE samples for which the analytes and concentrations are specified by a project chemist and unknown to the laboratory. Results from PE samples are used to evaluate the laboratory's ability to accurately identify and quantify target analytes.

Precision:

The reproducibility of a procedure demonstrated by the agreement between duplicate samples and analyses.

Quality assurance (QA):

The planning, implementation, and oversight conducted during the remedial investigation (RI) to ensure that the data produced meet the user's needs and can be used as intended for interpretation and decision making.

Quality assurance
objectives:

Precision, accuracy, completeness, representativeness, and comparability objectives. Both quantitative and qualitative objectives are established.

Quality assurance
project plan (QAPP):

A detailed document specifying guidelines and procedures to assure data quality during data gathering, analysis, and reporting.

Quality control (QC):

The system or a series of activities conducted to control and measure the validity and completeness of data produced.

Quantitation limit (QL):

The QLs established for each method are considered to represent levels needed to support data use and decision making. All laboratories must demonstrate that the method detection limit (MDL) for each analyte and method is equal to or less than the QLs presented in this QAPP or in subsequent analytical statements of work.

Relative percent
difference (RPD):

A measure of precision calculated by:

$$RPD = \frac{R1 - R2}{R_{ave}} \times 100$$

R1 = first result

R2 = second result

R_{ave} = average of the two results

Surrogate spike
compounds:

Compounds with characteristics similar to those of method analytes that are added to a sample prior to extraction. They are used to estimate the recovery of organic compounds in a sample.

Technical systems audits
(field and laboratory):

Evaluation of field and laboratory procedures to ensure that required protocols are being followed.

4.0 PROCEDURES

To satisfy the QC requirements for the RI, the following data assessment procedures are established:

- Perform an initial review of analytical and field data to ensure complete and accurate documentation, holding time compliance, and required frequency of QC samples;
- Evaluate blank results to identify systematic or sporadic contamination;
- Perform statistical calculations for accuracy and precision using the appropriate QC sample results;
- Estimate completeness in terms of the percent of estimated and unqualified data;
- Evaluate and summarize overall data quality for each defined dates;
- Assign data qualifier flags as necessary to reflect limitations; and
- Initiate corrective actions as necessary based on data review findings.

4.1 Review of Laboratory Data

Analytical reports and a copy of completed chain-of-custody form(s) are received from the laboratory. The reports and chain-of-custody forms are compared to ensure that all samples were analyzed as requested. Analytical reports are reviewed for the items listed below until the reviewer is confident that systematic errors no longer occur and that random errors are minimized. The following information is checked in at least 10% of the analytical reports:

- The date sampled agrees with that listed on the chain-of-custody form;
- The sample identification number matches that shown on the form;
- The analytes reported agree with the analyte list specified in the QAPP; and
- The detection or QLs meet the limits specified in the site specific QAPP and are correctly adjusted for sample dilution.

All analytical reports are reviewed for the items listed below. This list represents the minimum level of review; additional items may be reviewed depending upon the type of laboratory report requested:

- The method-specific holding times have been met for sample extraction/digestion and analysis, including second-column analysis for gas chromatograph (GC) methods;
- Laboratory control sample (LCS), surrogate, matrix, and analytical spike recoveries meet the project quality assurance objectives (QAOs) for accuracy;
- The relative percent difference (RPD) for LCS, matrix spike (MS), and laboratory and field duplicates meet the project QAOs for precision;
- Results are flagged when necessary, and complete, understandable comments are provided;
- The units are correct and consistent;
- The associated blanks are included with the laboratory report and meet the QAOs;
- The reported concentrations are within the calibration range; and
- The confirmation of GC analyses is performed as required in the QAPP, and analytical results are reported and include appropriate flags.

Also, the integrity of data stored in the database is verified by comparing approximately 10% of the entries to the laboratory reports. A higher percentage of results must be compared if the error rate indicates problems in the electronic data transfer step. The verification continues until the reviewer does not find any more systematic errors and the random error rate has been minimized.

Flagging Conventions

The following flags let the data user know if any quality problems are associated with a specific data point:

- U The material was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
- J The associated numerical value is an estimated quantity.
- UJ The material was analyzed for but not detected. The sample quantitation limit is estimated.
- R The data are unusable (analyte may or may not be present).
- N Presumptive evidence that the analyte is present, but result was not confirmed.

Laboratory QC Samples

For Method Blanks:

- Verify that a method blank was prepared and analyzed with every analytical batch for each matrix and level at a minimum frequency of one method blank for every 20 field samples.
- Determine whether any detected blank contaminant concentrations exceeded the QLs. If so, verify that the method blank and all associated samples in the analytical batch were reextracted and/or reanalyzed.

- Evaluate the associated method and field blanks. If an analyte was present in the method and field blanks for the same analytical batch, select the highest contaminant level. Qualify samples results for blank contaminants according to the following:

If the sample result was <5 times the maximum level in the associated method/field blanks, the result should be flagged with a "U" to indicate that the result should be considered not detected and is attributed to blank contamination. For common laboratory contaminants methylene chloride, acetone, 2-butanone, and phthalate esters, sample results <10 times the maximum blank level should be qualified as not detected values (U).

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD):

- Verify that a LCS/LCSD was prepared and analyzed with every analytical batch for each matrix at a minimum frequency of one LCS/LCSD pair per analytical batch.
- Verify that the appropriate analytes and surrogates were spiked and that the control limits for percent recoveries correspond to those listed in the project QAPP.
- If the spike recovery is > UCL and the reported sample results are less than the QL, the data are acceptable.
- If the spike recovery is > UCL or < LCL and the sample results are greater than the QL, qualify the data for these samples as estimated (J).
- If spike recovery is < < LCL (e.g., less than 10%), reject sample results.
- Evaluate the %RPD for all LCS/LCSD results. For LCS/LCSD outliers for %RPD, qualify all affected positive results in associated samples as estimated (J).

Matrix Spike/Matrix Spike Duplicate (MS/MSD):

- Verify that MS/MSD analyses were performed at a minimum frequency of one per 20 field samples for each matrix and level, and that a project field sample (not a field blank) was selected for MS/MSD analyses. (MS/MSD analyses is not required for air method TO-14, and some general chemistry methods). A MS/MSD pair must be performed for every analytical batch, but may not be performed on a project sample. Verify that this frequency was met and use the results for any non-project samples reported only for general assessment of method compliance. Review the original chain-of custody forms to determine which specific field samples were designated for MS/MSD analyses. If MS/MSD samples were identified on the chain-of-custody forms, verify that the laboratory spiked the correct sample for each analytical method.
- Verify that the appropriate analytes were spiked (including a polychlorinated biphenyl [PCB] for Method SWIOSO PCBs-only), and that the control limits for percent recovery (%R) and percent relative percent difference (%RPD) correspond to those listed in the project QAPP. However, spike recovery limits do not apply

when sample concentrations exceed the spike concentration by a factor of four or more.

- Identify all MS/MSD recoveries outside the %R control limits. If the MS and MSD recoveries for any analyte were both outside the %R control limits, verify that the LCS analyte recovery was within the control limits for that analytical batch. Alternately, verify that the entire analytical batch including the LCS and MS/MSD was reextracted and/or reanalyzed.
- If the spike recovery is greater than the upper control limit (UCL) and the reported sample results are less than the QL, the data are acceptable.
- If the spike recovery is > UCL or < the lower central limit (LCL) and the sample results are greater than the QL, further evaluate the sample concentrations and recoveries to determine whether the results represent a true matrix effect. Qualify data for spiked samples and similar matrix samples as necessary.
- Evaluate the %RPD for all MS/MSD results. For MS/MSD outliers for %RPD, qualify all affected positive results in the unspiked sample and all related samples (same matrix, site, etc.) from the same analytical batch as estimated (J).

Field QC Samples

Field Blanks:

- Verify that the appropriate field blanks were collected at the proper frequency for all analytical methods; and
- Evaluate the results for field blanks according to the procedure for method blanks.

Field Duplicates:

- Verify that field duplicates were collected at a minimum frequency of one per 10 samples for each matrix.
- Calculate %RPD for each positive result.
- Evaluate the precision for field duplicate results according to the QC criteria for %RPD specified in the QAPP. Identify all analytes with outlying RPD values for each field duplicate pair. Qualify all affected positive results in both samples as estimated (J) values.
- Evaluate results for occurrences where the analyte was reported in one sample, and ND in the other to identify variations in sample dilution that may affect the results. Note systematic or significant occurrences.

4.1.2 Sample Evaluation

Sample Holding Times

- Compare the actual sample holding times with the technical holding times listed in the QAPP.

- Whenever sample analyses exceed holding time limits, samples should be resampled.
- If sampling is impossible or infeasible, sample results may be evaluated as follows:

If the samples were properly preserved and stored, all positive results should be qualified as estimated (J) values. Non-detect results should be qualified as estimated (J) values if the sample holding time exceeded the limits by <1 week for water samples or <2 weeks for soil samples. Non-detect results should be rejected (R) as unacceptable for any samples with longer holding time violations.

Sample Preservation

- Compare actual sample preservation with sample preservation requirements listed in the project QAPP.
- Whenever sample preservation requirements are not met, samples must be resampled, or nondetected results rejected and positive results qualified as estimates.

Surrogate Recoveries (Organic Methods Only)

- For GC and GCIMS methods, verify that surrogate recoveries were reported and that the appropriate surrogate compounds and control limits were used.
- Verify that all surrogate recoveries were within QC limits, or that samples with outlying surrogate recoveries were reanalyzed. For BNA analyses, evaluate acid and base/neutral surrogates separately. Qualify results for samples with outlying surrogate recoveries as follows:

For surrogates recoveries exceeding QC limits, qualify positive results as estimated (J) values if one or two surrogates are used or if most surrogate recoveries are above QC limits.

For surrogate recoveries below QC limits but >10%, qualify all positive results and non-detects as estimated (J) values if a single surrogate is used or if most of surrogate recoveries are below QC limits.

For any surrogate recoveries < 10%, qualify all positive results as estimated (J) values and reject (R) all non-detect limits as unacceptable.

Confirmation Analysis (GC Methods Only)

- For GC methods, verify that second-column confirmation analysis was performed for any samples with results > the reporting limit in the original analysis. If the analyte was previously confirmed in the matrix, confirmation is not required. Also, if the analyte was confirmed, evaluate the data to ensure the laboratory

selected and identified the appropriate results from the original or confirmation analysis as the primary result.

- If second-column confirmation was required but not performed, all positive results should be qualified as estimated (J) values or NJ if there is substantiating evidence that the analyte was present (confirmed in other samples from the site).
- If an analyte was confirmed by a second-column analysis, determine the difference for the values (i.e., SW8010 is a factor of 3).
- If the factor exceeds the requirement, the primary sample result should be qualified as an estimated (J) value or professional judgment should be used.

4.2 Corrective Actions

Corrective actions are required for both random and systematic errors. Systematic errors are reproducible errors introduced by faulty instrumentation, methods, or techniques that affect the quality of a batch or set of data. Random errors are not repetitive and affect individual results. Prompt action is necessary to correct systematic errors and minimize the volume of data affected. Corrective action depends upon the source and extent of the problem. Corrective actions are documented in corrective action reports.

Corrective action for errors in reporting include (but are not limited to) the following:

- The QC reviewer issues an analytical request form (ARF) or similar form to the laboratory representative. This form is used for technical and non-technical errors, both systematic and random. The laboratory is required to submit corrected analytical reports when requested. Examples of technical errors which may be documented on this form are: LCSs exceeding control limits; QLs that do not meet the project-specified criteria; samples analyzed beyond the holding time; and method blank results with analytes greater than the quantitation limit. Examples of non-technical errors are inadequate narrative describing a problem, incorrect sample identification number, or incorrect sampling or analysis date. This type of report is also used to request missing data (sample or associated QC sample results).

If the electronic file contains errors, a new file is requested from the laboratory. If the error can easily be corrected, an erroneous entry originating from the electronic export file can be manually edited and documented.

4.3 Assessment of Completeness

Completeness is calculated after QC data have been evaluated and the results applied to the sample results. In addition to results outside QC limits (estimated and unusable), the occurrence of matrix effects, broken or spilled samples, or samples that could not be analyzed for any other reason are included in the assessment of completeness. The percentage of valid

results (including qualified data points) is reported as completeness and is compared to the completeness objective specified in the QAPP.

Completeness is calculated by dividing the number of valid results (the possible total number of results minus the number of unusable results and results not reported because of broken or spilled samples, etc.) by the total number of individual analyte results requested.

4.4 Data Assessment Report

A report discussing the QC sample results, performance audits, systems audits, and data validation is issued at the end of every sampling and analysis task. The information presented in the QA reports become an appendix to the task reports or are prepared as separate QA/QC reports and follow EPA format or a format specified in the scope of work (SOW).

The report summarizes data quality for the project or event and discusses systematic errors that may affect the precision or accuracy of all data for a given parameter or method, random errors affecting data quality discovered during data review and that could not be resolved, a discussion of holding time compliance, and a completeness assessment. Results of performance and system audits and data validation are also summarized in the QA report. Qualified results are presented in the summary section of the report in a table of qualified data, with the reason for qualification and analytes affected. Qualified data are also flagged in the database, so any tables or reports using the data indicate that the results are qualified or limited for use. The report includes a detailed assessment of blank, duplicate, and spike results and a comparison of these results to project DQOs.

An example of the content and format of a QA/QC report is presented in the following outline:

Example:

Quality Assurance Report/Quality Control Report

1.0 Executive Summary

1.1 Project Summary

- Number of field samples/methods/matrices

1.2 QA Summary

- Summarize QAPP procedures
- Summarize QA measures--audits, PE samples, data validation, confirmation samples

1.3 QC Summary

- Summarize overall data quality--identify systematic problems
- Summary of completeness by method--table
- Define qualifier flags

- 2.0 Introduction
 - 2.1 QA/QC program objectives and procedures
 - 2.2 Summary of QA/audits performed
 - 2.3 Summary of QC sample results
 - 2.4 Comparability of methods
- 3.0 Audits/QA Assessment
 - 3.1 QAPP QA requirements
 - Audits performed/required
 - PE samples/lab and field audits: Findings/corrective actions required/affect on data quality
 - Data validation results
- 4.0 Method assessment
 - Assessment of results by analytical method (for each method)
 - Statement of overall data quality/completeness-identify systematic problems
 - QC sample tables (blanks/spikes/duplicates) and brief discussion
- 5.0 Comparability
 - 5.1 Interlaboratory comparability (same method, different laboratory and field samples), if applicable
 - QC samples compared by method
 - Performance based QC limits (if sufficient data are produced)
 - 5.2 Comparison of screening data with confirmation sample results (different methods and labs, same field samples)
- 6.0 Data Storage
 - Documentation collected during the RI (chain-of-custody forms, data sheets, field calibration logs, lab reports, etc.)
 - Location of documentation
- 7.0 References

Prior to external distribution, the QA/QC report is reviewed by the project QA coordinator (QAC), other internal QA and project management personnel, and a technical editor prior to external distribution.

5.0 REFERENCES

1. Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, July 1988.
2. Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, February 1, 1988.
3. U.S. EPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, Revised June 1991.

4. EPA, 1995. Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents.

6.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE

SOP No: -032

Title: Surface Water Sampling

Effective Date: February 1999

1.0 PURPOSE

This SOP describes procedures for collecting surface water samples from streams, drainage channels, ponds, springs, caves or impoundments. Grab or composite samples may be collected at the water surface or at depth. This SOP describes planning, documentation, sample collection, and QC procedures for each type of surface water sampling.

2.0 APPLICABILITY

The procedures described in this SOP are applicable to investigations conducted to characterize surface water conditions. Sample locations, numbers, designation for grab or composite samples, and analytical parameters are specified in the SAP for the investigation.

3.0 TERMS AND DEFINITIONS

Grab sample: A single sample collected from a location/depth.

Composite sample: A sample comprised of a designated number of subsamples that have been combined. A composite sample represents the water's overall composition.

Drainage: Natural or channeled streambed or storm runoff drainage channel.

Impoundment: Body of water created by a dam, berm, or other man-made structure.

Van Dorn sampler: Type of sampler used to collect a discrete sample at depth. A weighted "messenger" trips the end caps of a PVC tube to isolate a sample from the desired depth.

Kemmerer sampler: A sample collection device similar to a Van Dorn sampler. Used to collect a discrete sample at depth.

SAP: Sampling and Analysis Plan.

OVA: Organic vapor analyzer.

OVM: Organic vapor meter.

PVC:	Polyvinyl chloride.
QC:	Quality control.
SOP:	Standard operating procedure.
VOC:	Volatile organic compound.

4.0 EQUIPMENT AND PROCEDURES

4.1 Equipment and Supplies

- Data sheets, maps, sample labels, and other documentation designated for the sampling activity.
- Sample containers and preservatives.
- Filtration apparatus (if samples are to be analyzed for dissolved constituents).
- Coolers with ice.
- Field meters (pH, OVA/OVM, conductivity, dissolved oxygen, etc.) to conduct field measurements designated in the SAP.
- Weighted measuring tape for depth measurements.
- Decontamination supplies.
- Gloves.
- Van Dorn, Kemmerer, automatic sampler, or sample container as designated in the SAP.
- Stainless steel bucket or Teflon beaker for mixing composite samples.

4.2 Decontamination

Decontaminate all equipment using the procedures given in Section 4.2.1 of SOP-013.

4.3 Procedures

Surface water sampling involves the following steps or activities: planning, recordkeeping/documentation, field and QC sample collection, and sample handling and shipment.

4.3.1 Planning

Planning for surface water sample collection involves:

- Selecting and visually verifying sampling locations during SAP development. All sample locations should be clearly designated on site maps prepared using a scale that allows the field team to correctly locate each sampling point. If possible, locations should also be designated by northing and easting from obvious reference points (building corners, street intersections, monitoring wells). If not

designated in the SAP, these measurements must be recorded during sample collection.

- Scheduling laboratory capacity and field staff prior to field activities. This should be done at least several weeks prior to the field effort.
- Acquiring needed sampling equipment and supplies.
- Compiling or developing data sheets and other documentation forms.

4.3.2 Sample Collection

The surface water feature, the type of sample (grab or composite), and the analytical parameters will dictate the type of equipment used to collect samples.

Grab samples are collected by immersing the sample container in the water to be sampled (when possible). This eliminates the potential for cross contamination from sampling equipment. To collect a grab sample, perform the applicable steps described below.

1. Planning should be performed to identify the most logical order for sample collection. Sampling from a drainage ditch or stream should begin with background locations, the furthest downstream location, or the location furthest from any suspected contaminant source. This minimizes the potential for cross-contamination or influencing downstream samples by disturbing sediment that can be carried downstream. If samples are being collected from a pond or impoundment, samples furthest from a discharge point or inlet that could be a source of contamination should be collected first.
2. At each sampling location, initiate a sample collection data sheet (developed for the sampling activity) by recording the location number, date, time, and sampler's initials.
3. Calibrate or verify calibration as needed for field instruments (calibration may be performed at the staging area at the beginning of the day). Perform field measurements as designated in the SAP. This will include pH, conductivity, and temperature at a minimum. Other measurements such as OVA/OVM organic vapor readings, radioactivity screening, depth, and/or dissolved oxygen may be designated in the SAP. Record results on the data sheet.
4. Wear new, clean, surgical-type gloves to avoid contamination of the sample or container.
5. If the water is deep enough, collect samples by submerging the sample container into the water. The opening of the container must be pointed upstream, above the sampler's hands and feet. Cap immediately, dry the outside of the bottle, and affix a completed sample label.

6. If the water is too shallow to submerge the sample containers, use a decontaminated stainless-steel bucket or Teflon beaker to collect enough water for all sample containers. Carefully decant the water from the bucket or beaker into the sample containers. Note: Samples for VOC analysis cannot be collected in this manner; the sample containers must be submerged. Be sure to note any problems or conditions that could cause VOC loss. An alternative to increase water depth for collecting grab samples is to temporarily dam the streamflow or to dig a shallow depression. Collect samples after the disturbed sediment has cleared.
7. If composite samples are to be collected (for non-volatile parameters only), collect the same volume of water from each location and place in a decontaminated bucket. After all samples are collected, gently mix the water and pour into sample containers as designated for analysis.
8. If samples will be analyzed for dissolved inorganic constituents, collect the samples in a bucket or beaker and filter the sample directly into the container. An alternative is to perform filtration at the staging area as soon as possible. In this case, collect a large enough volume of sample to allow for later filtration. Filter the samples into new, clean sample containers.
9. Decontaminate the bucket or beaker by scrubbing with water and detergent, rinsing with potable water, and rinsing with DI water. Decontaminate field meters and the measuring tape by the same procedure.
10. Collect equipment blanks at the frequency designated in the SAP or QAPP by pouring DI water into the bucket or beaker, swirling it gently, and pouring into sample containers.
11. Trip blanks may be collected if VOC samples are being collected. Trip blanks consist of filled VOC sample containers handled along with the other sample containers and shipped in the same coolers that are not opened until analysis at the laboratory.

Grab Samples at Depth

If samples are being collected at depth from a pond, impoundment, or stream, a Van Dorn or Kemmerer sampler is used. Samples are collected as follows:

1. At the sampling location, perform Steps 2 through 4 as described above for grab samples.
2. Prepare the sampler by pulling the end caps away from the tube and securing them with the spring-loaded "triggers" as appropriate for the type of sampler.

3. Lower the sampler to the desired depth and release the weighted messenger. The line must be straight and taut so the messenger can properly trip the end caps. Note: This type of sampler may be accidentally tripped by sudden movements, being knocked against other objects, or by being lowered too quickly. In some cases, the messenger may not trip the end caps and the sampler will not close. The sampler may need to be lowered to depth repeatedly to collect a sample. Close attention is needed to monitor either of these conditions and ensure that valid samples are collected.
4. Raise the sampler and open one end. Carefully pour the water into designated sample containers. Label samples, complete documentation and ship samples as required. If filtration is required, pour the sample into a decontaminated bucket for easier use of the filter apparatus.
5. Collect composite samples as described in Step 7 for grab samples.
6. Collect trip and equipment blanks as designated in the SAP or field instructions.
7. Decontaminate the sampling equipment by scrubbing with potable water and detergent, steam cleaning, rinsing with potable water and DI water, rinsing with cyclohexane and methanol, and a final rinse with DI water.